

**PHY • PHYSICS**

08. Electrostatics

Official PMDC Solved Past Paper Topical Booklet • High-Yield Examination Series

© 131 Solved Questions

📅 2009 to 2024 Archive

🛡 Boards: BUMHS, DUHS, KMU, KU, MDCAT, NUMS

📄 Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

SZABMU 2024

Q.178 The electric flash attachment to a camera contains a capacitor for storing the energy used to produce the flash. In one such unit, the potential difference between the plates of 20 F capacitor is 5 V. Calculate the energy that is used to produce the flash? [SZABMU 2024]

- (A) 250 J
- (B) 310 J
- (C) 500 J
- (D) 650 J

Q2.

SZABMU 2024

Q.179 Electron-volt is the unit of [SZABMU 2024]

- (A) Charge
- (B) Current
- (C) Electric potential
- (D) Energy

Q3.

SZABMU 2024

Q.180 Which one of the following is the unit of electric field intensity? [SZABMU 2024]

- (A) Newton per Ampere
- (B) Newton per volt
- (C) Volt per Coulomb
- (D) Volt per meter

Q4.

SZABMU 2024

Q.181 The SI-unit of relative permittivity is/has [SZABMU 2024]

- (A) $\frac{C^2}{N m^2}$
- (B) $\frac{C}{N m^2}$
- (C) $\frac{C^{-2}}{N m}$
- (D) No unit

Q5.

SZABMU 2024

Q.182 The electrostatic force between two point-charges is independent of one of the following quantities? [SZABMU 2024]

- (A) Distance between charges
- (B) Magnitude of charges
- (C) Medium between charges
- (D) Temperature of charges

Q6.

SZABMU 2024

Q.183 How many electrons are there in one Coulomb charge? [SZABMU 2024]

- (A) 6.25×10^{15}
- (B) 6.25×10^{16}
- (C) 6.25×10^{17}
- (D) 6.25×10^{18}

Q7.

SZABMU 2024

Q.184 The SI-unit of capacitance of capacitor is Farad, it can also be expressed as [SZABMU 2024]

- (A) $\frac{A^2 s^2}{Nm}$
- (B) $\frac{A^2 s^3}{Nm}$
- (C) $\frac{A^3 s}{Nm}$
- (D) $\frac{A^2 s}{Nm}$

Q8.

KU 2024

Q.185 What is the increase in force between two charges if the separation between them is decreased by 50 percent? [KU 2024]

- (A) Becomes four times
- (B) Doubles
- (C) Increases by half
- (D) Triples

Q9.

KU 2024

Q.186 According to Coulomb's law, what happens to the electrostatic force between the 2-point charges if the distance between them is doubled? [KU 2024]

- (A) The force becomes one-fourth
- (B) The force becomes half
- (C) The force doubles
- (D) The force remains the same

Q10.

KU 2024

Q.187 What does one Coulomb represent in terms of charges? [KU 2024]

- (A) The amount of charge transported by a current of 1 Ampere in 1 second
- (B) The charge of 1 proton
- (C) The charge of 1 electron
- (D) The charge required to create a force of 1 Newton between two charges separated by 1 meter

Q11.

KU 2024

Q.188 Two points charges, $+5\mu C$ and $-5\mu C$ are placed at points A and B, respectively, which are separated by a distance $2d$. What is the electric potential at the midpoint M of the line joining A and B? [KU 2024]

- (A) $2kQ/d$
- (B) kQ/d
- (C) $-kQ/d$
- (D) Zero

Q12.

KU 2024

Q.189 In the case of a parallel plate capacitor, when the distance between the two plates is reduced to half and the area of the plate doubled, the capacitance [KU 2024]

- (A) Increases four times
- (B) Increases six times
- (C) Is doubled
- (D) Remains the same

Q13.

KU 2024

Q.190 If the dielectric material between the plates of the capacitor is removed, what happens to the electric field between the plates? [KU 2024]

- (A) The electric field becomes zero
- (B) The electric field decreases
- (C) The electric field increases
- (D) The electric field remains the same

Q14.

KU 2024

Q.191 Capacitance of a capacitor increases with decrease in: [KU 2024]

- (A) Dielectric constant
- (B) Plate area
- (C) Permittivity
- (D) Plate separation

Q15.

KU 2024

Q.192 Electron Volt (eV) is another unit of [KU 2024]

- (A) Charge
- (B) Current
- (C) Energy
- (D) Power

Q16.

UHS 2024

Q.193 Which one of the following is NOT a feature of electric forces? [UHS 2024]

- (A) They act on charges
- (B) They act on masses
- (C) They can be attractive
- (D) They can be repulsive

Q17.

UHS 2024

Q.194 Find potential difference in moving 2 C charge which requires 600 J of work between two points.

[UHS 2024]

- (A) 1200 V
- (B) 300 V
- (C) 150 V
- (D) 2400 V

Q18.

UHS 2024

Q.195 Electric intensity between two oppositely charge plates in the middle region is **[UHS 2024]**

- (A) Non-uniform
- (B) Uniform
- (C) Cannot be predicted
- (D) Variable

Q19.

UHS 2024

Q.196 The S.I unit of capacitance of a capacitor is: **[UHS 2024]**

- (A) Coulomb
- (B) Volt
- (C) Farad
- (D) Ampere

Q20.

UHS 2024

Q.197 The Coulomb's law states **[UHS 2024]**

- (A) Force between two point charges is inversely proportional to the product of the charges and directly proportional to the square of the distance between them
- (B) Force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them
- (C) Force between two-point charges is directly proportional to the sum of the charges and inversely proportional to the square of the distance between them
- (D) Force between two-point charges is directly proportional to the product of the charges and the square of the distance between them

Q21.

UHS 2024

Q.198 The formula $V = W/q_0$ represents **[UHS 2024]**

- (A) Electric intensity
- (B) Electric power
- (C) Electric potential
- (D) Electric field gradient

Q22.

NUMS 2024

Q.199 Capacitor cannot be fully charge because time required to charge **[NUMS 2024]**

- (A) 1 time constant
- (B) 2 times constant
- (C) 4 times constant
- (D) Infinity

Q23.

NUMS 2024

Q.200 At midpoint P

**[NUMS 2024]**

- (A) $V = 0, E \neq 0$
- (B) $V = 0, E = 0$
- (C) $V \neq 0, E \neq 0$
- (D) $V \neq 0, E = 0$

Q24.

NUMS 2024

Q.201 A particle have a charge of 1C falls through a potential difference of 5 V. The energy required by it is: **[NUMS 2024]**

- (A) $1.6 \times 10^{-19} \text{ J}$
- (B) $5 \times 10^{-19} \text{ J}$
- (C) 6 J
- (D) 5 J

Q25.

NUMS 2024

Q.202 If the value of electric field intensity between the plates increases two times then energy stored in a capacitor becomes: **[NUMS 2024]**

- (A) Double
- (B) Half
- (C) One Forth
- (D) Quadruple

Q26.

BUMHS 2024

Q.203 A fully charged capacitor with charge q and capacitance C is connected across a resistor R in series. Power dissipated across resistor will be zero after time: [BUMHS 2024]

- (A) $t = 0$
- (B) $t = RC$
- (C) $t = 5RC$
- (D) $t = \infty$

Q27.

BUMHS 2024

Q.204 A dielectric for a capacitor can be
I. polar
II. non-polar [BUMHS 2024]

- (A) II
- (B) both I and II
- (C) neither I nor II
- (D) I

Q28.

BUMHS 2024

Q.205 The electric potential at a point in an electric field is the amount of work done to move: [BUMHS 2024]

- (A) any amount of charge from infinity to that point
- (B) a unit positive charge from infinity to that point
- (C) any amount of charge from any position to that point
- (D) a unit negative charge from infinity to that point

Q29.

BUMHS 2024

Q.206 A spherical liquid drop has a diameter of 2cm and is given a charge of 1mC. The potential at the surface of the drop is [BUMHS 2024]

- (A) 900 MV
- (B) 0.9 MV
- (C) 0.45 MV
- (D) 4.5 MV

Q30.

UHS 2023

Q.147 A capacitor of capacitance ' C ' has a charge ' Q ' and stored energy is ' W '. If the charge is increased to ' $2Q$ '. The stored energy will be: [UHS 2023]

- (A) $2W$
- (B) $4W$
- (C) $W/4$
- (D) $W/2$

Q31.

UHS 2023

Q.148 To store the electric charge the ultra-capacitors, use ____ effect. [UHS 2023]

- (A) Single layer
- (B) Double layer
- (C) Triple layer
- (D) Quadruple layer

Q32.

UHS 2023

Q.149 What is the potential difference between two points in an electric field if it takes 600J of energy of move a charge of 2 C between these two points? [UHS 2023]

- (A) 1200 V
- (B) 800 V
- (C) 300 V
- (D) 0 V

Q33.

UHS 2023

Q.150 A charged particle moves in a uniform electric field between two oppositely charged parallel metal plates. To calculate the force acting on the particle due to the electric field, which quantity is not required? [UHS 2023]

- (A) Particle charge
- (B) Particle speed
- (C) Plate separation
- (D) Potential difference between the plates

Q34.

UHS 2023

Q.151 Gauss's law cannot be used to find which of the following quantity? [UHS 2023]

- (A) Electric field intensity
- (B) Electric flux density
- (C) Charge
- (D) Permittivity

Q35.

UHS 2023

Q.152 Electric field intensity inside a hollow charged sphere is: [UHS 2023]

- (A) Zero
- (B) Maximum
- (C) Negative
- (D) Positive

Q36.

UHS 2023

Q.153 As per Coulomb's law, the force of attraction or repulsion between two-point charges is directly proportional to the: [UHS 2023]

- (A) Sum of the magnitude of charges
- (B) Square of the distance between them
- (C) Product of the magnitude of charges
- (D) Cube of the distance

Q37.

SZABMU 2023

Q.154 The relative permittivity of air (1 atm) is: [SZABMU 2023]

- (A) 1
- (B) 1.0006
- (C) 22.25
- (D) 2.284

Q38.

SZABMU 2023

Q.155 Equivalent capacitance is less than least value of capacitance in a combination in: [SZABMU 2023]

- (A) Series
- (B) Parallel
- (C) Closed circuit
- (D) Open circuit

Q39.

SZABMU 2023

Q.156 The magnitude of the force between two-point charges is directly proportional to: [SZABMU 2023]

- (A) Distance between point charges
- (B) Square of distance between point charges
- (C) Cube of distance between point charges
- (D) Product of magnitude of charges

Q40.

SZABMU 2023

Q.157 When dielectric is placed between the plates of a capacitor then capacitance will: [SZABMU 2023]

- (A) Decrease
- (B) Increase
- (C) Becomes half
- (D) Remains same

Q41.

SZABMU 2023

Q.158 A one micro farad capacitor of a TV is subjected to 4000 V potential difference. The energy stored in capacitor is: [SZABMU 2023]

- (A) 16
- (B) 4×10^{-3} J
- (C) 2×10^{-3} J
- (D) 8 J

Q42.

SZABMU 2023

Q.159 A particle carrying a charge $2e$ falls through a P.D of 3 V. The energy acquired will be: [SZABMU 2023]

- (A) 6 eV
- (B) 7 eV
- (C) 1.5 eV
- (D) 5 eV

Q43.

SZABMU 2023

Q.160 Due to polarization process of dielectric, the electric intensity: [SZABMU 2023]

- (A) Increases
- (B) Decreases
- (C) Remains same
- (D) Becomes zero

Q44.

KMU 2023

Q.161 Two charges of magnitude $q_1 = 1\mu\text{C}$ and $q_2 = 5\mu\text{C}$, are separated at a distance $r = 1 \times 10^{-3}$ m apart, the ratio of the magnitude of the forces acting on them will be: [ETEA 2023]

- (A) 1:5
- (B) 1:25
- (C) 1:3
- (D) 1:1

Q45.

KMU 2023

Q.162 Two equal and opposite charges of 10C are separated at a distance of 10 cm, the electric potential at mid-point between the charges is [ETEA 2023]

- (A) 20 V
- (B) 10 V
- (C) 5 V
- (D) 0 V

Q46.

KMU 2023

Q.163 The force of repulsion between two alike charges is 10N in vacuum. When a material of $\epsilon_r = 2$ is placed between them, new force will be: [ETEA 2023]

- (A) 20 N
- (B) 15 N
- (C) 10 N
- (D) 5 N

Q47.

KMU 2023

Q.164 The slope of the charge–time graph for a charging capacitor gives: [ETEA 2023]

- (A) Current
- (B) Voltage
- (C) Force
- (D) Energy

Q48.

KMU 2023

Q.165 Two small charged objects attract each other with a force F when separated by a distance d . If the charge on each object is reduced to $q/2$ the force becomes: [ETEA 2023]

- (A) $F/16$
- (B) $F/8$
- (C) $F/4$
- (D) $F/2$

Q49.

KMU 2023

Q.166 If both the plate area and the plate separation of a parallel–plate capacitor are doubled, the capacitance is: [ETEA 2023]

- (A) Doubled
- (B) Halved
- (C) Unchanged
- (D) Tripled

Q50.

KMU 2023

Q.167 A $20\mu\text{F}$ capacitor is charged to 200 V, its stored energy is: [ETEA 2023]

- (A) 4000 J
- (B) 4 J
- (C) 0.4 J
- (D) 2000 J

Q51.

DUHS 2023

Q.168 The change in electric potential with respect to distance equals to: [SINDH 2023]

- (A) Potential gradient
- (B) Amount of the charge
- (C) Potential difference
- (D) Surface charge density

Q52.

DUHS 2023

Q.169 The amount of energy required in moving an electron of charge (e) by the application of 1 volt potential difference equals to [SINDH 2023]

- (A) 1 keV
- (B) 1 MeV
- (C) 1 GeV
- (D) 1 eV

Q53.

DUHS 2023

Q.170 Which law explains the relation between amount of charges and force between them? [SINDH 2023]

- (A) Ohm's law
- (B) Lenz's law
- (C) Coulomb's law
- (D) Ampere's law

Q54.

DUHS 2023

Q.171 What does the electric field around a charge represent? [SINDH 2023]

- (A) Size of the charge
- (B) Effective area for electrostatic force
- (C) Path followed by the charge
- (D) Speed of the charge

Q55.

DUHS 2023

Q.172 1 N/C equals to [SINDH 2023]

- (A) 1 V/m
- (B) 1 J/C
- (C) 1 C/m³
- (D) 1 J/sec

Q56.

DUHS 2023

Q.173 Which statement is the best for electric flux of a point charge? [SINDH 2023]

- (A) Independent of charge
- (B) Independent of medium
- (C) Independent of shape of surface in which charge is enclosed
- (D) Independent position of charge in space

Q57.

DUHS 2023

Q.174 Two capacitors $6\mu\text{F}$ and $12\mu\text{F}$ are in series connected across a 200 volts D.C supply calculate the charges on each capacitor, respectively. [SINDH 2023]

- (A) $8 \times 10^{-4} \text{ C}$, $8 \times 10^{-4} \text{ C}$
- (B) $1.8\mu\text{C}$, $8\mu\text{C}$
- (C) $1.8 \times 10^{-4} \text{ C}$, $16 \times 10^{-4} \text{ C}$
- (D) 800 C, 800 C

Q58.

NUMS 2023

Q.175 While studying charging and discharging of a capacitor, $RC = \text{Resistance} \times \text{capacitance}$ is known as? [NUMS 2023]

- (A) Electrostatic constant
- (B) Time constant
- (C) Dielectric constant
- (D) Proportionality constant

Q59.

NUMS 2023

Q.176 In parallel combination of two capacitors, their equivalent capacitance is equal to: [NUMS 2023]

- (A) $C_1 + C_2$
- (B) $1/C_1 + 1/C_2$
- (C) $\frac{C_1 C_2}{C_1 + C_2}$
- (D) $\frac{2C_1 C_2}{C_1 + C_2}$

Q60.

NUMS 2023

Q.177 The SI unit of capacitance of a capacitor is: [NUMS 2023]

- (A) Coulomb
- (B) Volt
- (C) Farad
- (D) Ampere

Q61.

UHS 2022

Q.121 A capacitor is charged with a battery and energy stored is U . After disconnecting battery another capacitor of same capacity is connected in parallel to the first capacitor. Then energy stored in each capacitor is [UHS 2022]

- (A) $U/2$
- (B) $U/4$
- (C) $4U$
- (D) $2U$

Q62.

UHS 2022

Q.122 What is the potential difference between two points in an electric field if it takes 600J of energy to move a charge of 2C between these two points? [UHS 2022]

- (A) 1200 V
- (B) 800 V
- (C) 300 V
- (D) 0 V

Q63.

UHS 2022

Q.123 Gauss law cannot be used to find which of the following quantity? [UHS 2022]

- (A) Electric field intensity
- (B) Electric flux
- (C) Charge
- (D) Permittivity

Q64.

UHS 2022

Q.124 Which one of the following statements is true? [UHS 2022]

- (A) Electrostatic force obeys inverse square law while gravitational force does not
- (B) Both gravitation force and electrostatic force are repulsive in nature
- (C) Gravitational force is much weaker than electrostatic force
- (D) Both electrostatic force and gravitational force don't obey inverse square law

Q65.

UHS 2022

Q.125 The Coulomb's constant k depends upon? [UHS 2022]

- (A) Nature of medium
- (B) System of units
- (C) Types of charge
- (D) Nature of medium and system of units

Q66.

UHS 2022

Q.126 A charged particle is moving in a uniform electric field. For the motion of the particle due to the field, which quantity has a constant non-zero value? [UHS 2022]

- (A) Acceleration
- (B) Displacement
- (C) Rate of change of acceleration
- (D) Velocity

Q67.

UHS 2022

Q.127 A capacitor of capacitance 'C' has a charge 'Q' and stored energy is 'W'. If the charge is increased to '2Q'. The stored energy will be: [UHS 2022]

- (A) 2W
- (B) 4W
- (C) W/4
- (D) W/2

Q68.

SZABMU 2022

Q.128 Electric intensity due to charge distributions are calculated using which following law? [SZABMU 2022]

- (A) Ohm's law
- (B) Faraday's law
- (C) Gauss's law
- (D) Ampere's law

Q69.

SZABMU 2022

Q.129 The capacitance of capacitor does not depend on: [SZABMU 2022]

- (A) Area of plates
- (B) Medium
- (C) Distance between plates
- (D) Thickness of plates

Q70.

SZABMU 2022

Q.130 The SI unit of potential difference is: [SZABMU 2022]

- (A) Volt
- (B) Coulomb
- (C) Watt
- (D) eV

Q71.

SZABMU 2022

Q.131 Electric potential is defined as: [SZABMU 2022]

- (A) Work per unit charge
- (B) Force per unit charge
- (C) Power per unit charge
- (D) Force

Q72.

SZABMU 2022

Q.132 1 eV is equal to: [SZABMU 2022]

- (A) 1.602×10^{-19} J
- (B) 16.02×10^{-19} J
- (C) 1620 J
- (D) 162.0×10^{-19} J

Q73.

KMU 2022

Q.133 The energy stored in a capacitor is given by: [ETEA 2022]

- (A) $U = \frac{1}{2} QV^2$
- (B) $U = \frac{1}{2} CV^2$
- (C) $U = \frac{1}{2} QC$
- (D) $U = \frac{1}{2V}$

Q74.

KMU 2022

Q.134 Two charges one of which is $Q_1 = 3\mu\text{C}$ and second one is $Q_2 = -1\mu\text{C}$ are separated by 100 cm. The electric potential is zero at a point [ETEA 2022]

- (A) 25 cm from Q_2
- (B) 75 cm from Q_2
- (C) 50 cm from Q_1
- (D) 33.3 cm from Q_1

Q75.

BUMHS 2022

Q.135 The electric field intensity at a point situated 4 m from a point charge is 200 N/C. If the distance is reduced to 2 m, what will be field intensity? [BMU 2022]

- (A) 400 N/C
- (B) 800 N/C
- (C) 600 N/C
- (D) 1200 N/C

Q76.

BUMHS 2022

Q.136 Which type of energy does the capacitor store? [BMU 2022]

- (A) Kinetic
- (B) Potential
- (C) Thermal
- (D) Light

Q77.

BUMHS 2022

Q.137 When the distance between two charged particles is halved, the Coulomb force between them becomes [BMU 2022]

- (A) One fourth of the initial force
- (B) Four times the initial force
- (C) Double the initial force
- (D) One half of the initial force

Q78.

DUHS 2022

Q.138 In equation $E = -\frac{\Delta V}{\Delta r}$. Negative sign indicates that: [DUHS 2022]

- (A) 'E' point towards increasing 'V'
- (B) 'E' point towards decreasing 'V'
- (C) 'E' is perpendicular 'V'
- (D) 'E' is parallel to ' ΔV '

Q79.

DUHS 2022

Q.139 The electric field intensity between two uniformly, oppositely charged parallel plates is: [DUHS 2022]

- (A) $\frac{\sigma}{2\epsilon_0}$
- (B) $\frac{\epsilon_0}{\sigma}$
- (C) $\frac{2\sigma}{\epsilon_0}$
- (D) $\frac{\sigma}{\epsilon_0}$

Q80.

DUHS 2022

Q.140 If $2\mu\text{F}$ and $4\mu\text{F}$ capacitors are connected in series. Their equivalent capacitance will be: [DUHS 2022]

- (A) $8\mu\text{F}$
- (B) $0.75\mu\text{F}$
- (C) $1.33\mu\text{F}$
- (D) $6\mu\text{F}$

Q81.

DUHS 2022

Q.141 A proton of charge $1.6 \times 10^{-19} \text{ C}$ is moved through a P.D of 20 V. The energy gained by the proton is: [DUHS 2022]

- (A) $-32 \times 10^{-19} \text{ J}$
- (B) $32 \times 10^{-19} \text{ J}$
- (C) $-32 \times 10^{19} \text{ J}$
- (D) $32 \times 10^{19} \text{ J}$

Q82.

DUHS 2022

Q.142 Two similar point charges, each of 1 coulomb, placed in free space 1m apart, repel each other with a force of: [DUHS 2022]

- (A) $8.85 \times 10^{-12} \text{ N}$
- (B) $1.602 \times 10^{-19} \text{ N}$
- (C) 1 N
- (D) $9 \times 10^9 \text{ N}$

Q83.

DUHS 2022

Q.143 If a slab of dielectric constant $\epsilon_r = 2$ is inserted between the parallel plates of a charged $20\mu\text{F}$ capacitor. Its capacitance will: [DUHS 2022]

- (A) Remain the same
- (B) Be four times
- (C) Be doubled
- (D) Be halved

Q84.

NUMS 2022

Q.144 Energy stored in a capacitor is given by: [NUMS 2022]

- (A) $E = \frac{1}{2}CV^2$
- (B) $E = 2CV^2$
- (C) $E = CV^2$
- (D) $E = CV$

Q85.

NUMS 2022

Q.145 Electric field intensity is: [NUMS 2022]

- (A) Force per unit mass
- (B) Force per unit tesla
- (C) Force per unit charge
- (D) Force per unit watt

Q86.

NUMS 2022

Q.146 It stores electrical potential energy: [NUMS 2022]

- (A) Capacitor
- (B) Conductor
- (C) Inductor
- (D) Generator

Q87.

PMDC 2021

Q.114 Electric force and electric field intensity for a charge are [NMDCAT 2021]

- (A) Parallel to each other
- (B) Opposite to each other
- (C) Perpendicular to each other
- (D) At any orientation

Q88.

PMDC 2021

Q.115 A charge Q placed at the centre of two charges + q and + q. the system is in equilibrium then net force experienced by Q. [NMDCAT 2021]

- (A) Zero
- (B) F
- (C) At equilibrium, net force will be zero
- (D) F/2

Q89.

PMDC 2021

Q.116 In series combination of capacitors [NMDCAT 2021]

- (A) $C_1 + C_2 + C_3$
 (B) $\frac{C_1 C_2}{C_1 + C_2}$
 (C) $\frac{C_1 + C_2}{C_1 C_2}$
 (D) $\frac{1}{C_1 + C_2 + C_3}$

Q90.

PMDC 2021

Q.117 Work done per unit coulomb is equal to [NMDCAT 2021]

- (A) Electric field
 (B) Magnetic field
 (C) Electric potential
 (D) None

Q91.

PMDC 2021

Q.118 Work on charge is equipotential surface is [NMDCAT 2021]

- (A) +ve
 (B) -ve
 (C) Zero
 (D) None

Q92.

PMDC 2021

Q.119 Capacitance of spherical capacitor is [NMDCAT 2021]

- (A) $4\pi\epsilon \left(\frac{ab}{b-a} \right)$
 (B) $4\pi\epsilon(b-a)$
 (C) $4\pi\epsilon/(b-a)$
 (D) None

Q93.

PMDC 2021

Q.120 For n numbers of Capacitors, each of the capacitance 'C' what will be the ratio between maximum and minimum capacitor? [NMDCAT 2021]

- (A) n
 (B) n^2
 (C) n^3
 (D) n^4

Q94.

PMDC 2021

[PMC Practice 8]

The energy stored in a parallel plate capacitor is 24 J. What is the potential difference across its plates if the capacitance is $3\mu\text{F}$?

- (A) 16 kV
 (B) 54 kV
 (C) 8 kV
 (D) 4 kV

Q95.

PMDC 2020

Q.108 If the potential at a point which is 1m from a charge is 1volt, then the potential at a point which is 2m from the same charge will be: [NMDCAT 2020]

- (A) 2 V
 (B) 1V
 (C) 0.5 V
 (D) 3 V

Q96.

PMDC 2020

Q.109 The values of electric intensity will ____ due to the presence of dielectric medium: [NMDCAT 2020]

- (A) Increase
 (B) Increase exponentially
 (C) Decrease
 (D) Remains same

Q97.

PMDC 2020

Q.110 In capacitors, energy is stored in the form of: [NMDCAT 2020]

- (A) Gravitational energy
 (B) Kinetic energy
 (C) Electric intensity
 (D) Magnetic energy

Q98.

PMDC 2020

Q.111 Ohm time's farad is equivalent to: [NMDCAT 2020]

- (A) Time
 (B) Charge
 (C) Distance
 (D) Capacitor

Q99.

NUMS 2020

Q.112 By increasing area of the plates and decreasing distance between them the capacitance of capacitor: [NUMS 2020]

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Depending upon temperature

Q100.

NUMS 2020

Q.113 If we double the separation between two charges, then coulomb's force will become? [NUMS 2020]

- (A) Doubled
- (B) Half
- (C) 4-times
- (D) $1/4^{\text{th}}$

Q101.

MDCAT 2019

Q.105 Electric field strength of a point charge is E and electric potential is V at a distance r from the point charge. What is the electric potential at a point for the same point charge where electric field strength is $E/4$? [MDCAT 2019]

- (A) $V/4$
- (B) $4V$
- (C) $V/2$
- (D) $2V$

Q102.

MDCAT 2019

Q.106 A particle carrying a charge of $5e$ falls through a potential difference of $25V$. What would be energy acquired by the particle in 'J'. [MDCAT 2019]

- (A) $125 \times 10^{-19} \text{ J}$
- (B) $1.6 \times 10^{-19} \text{ J}$
- (C) $125 \times 1.6 \times 10^{-19} \text{ J}$
- (D) 125 J

Q103.

MDCAT 2019

Q.107 Electric field strength at a point between oppositely charge plates is E . If the distance between plates is reduced to half, what will be the new value of electric intensity? [MDCAT 2019]

- (A) $4E$
- (B) $E/2$
- (C) $E/4$
- (D) $2E$

Q104.

MDCAT 2018

Q.97 Coulomb's law is given by the formula $F = k \frac{q_1 q_2}{r^2}$. The magnitude of k having the unit of Nm^2C^{-2} for free space is equal to [MDCAT 2018]

- (A) 9×10^7
- (B) 6×10^7
- (C) 10×10^9
- (D) 9×10^9

Q105.

MDCAT 2018

Q.98 Force experienced per unit positive test charge at a point in an electric field is the definition of: [MDCAT 2018]

- (A) Electric potential energy
- (B) Electric field strength
- (C) Electric potential
- (D) Electric field

Q106.

MDCAT 2018

Q.99 A torch is rated 2.2 V , 0.25 A . Calculate the charge passing through the bulb in one second and energy transferred by the passage of each coulomb of charge. [MDCAT 2018]

- (A) 2.5 C and 0.55 J
- (B) 0.25 C and 2.2 J
- (C) 0.25 C and 2.2 V
- (D) 0.25 C and 0.55 J

Q107.

MDCAT 2018

Q.100 Electric potential due to $2\mu\text{C}$ charge at distance of one meter is equal to [MDCAT 2018]

- (A) $18 \times 10^4 \text{ volt}$
- (B) $1.8 \times 10^6 \text{ volt}$
- (C) $1.8 \times 10^3 \text{ volt}$
- (D) $1.8 \times 10^4 \text{ volt}$

Q108.

KMU 2018

Q.101 Two determine the resistance of a voltmeter by discharging a capacitor through it, the instantaneous voltage is then given by the relation: [ETEA 2018]

- (A) $V_0 e^{-t/RC}$
- (B) $V_0 e^{+t/RC}$
- (C) $V_0/2$
- (D) $V_0/\sqrt{2}$

Q109.

KMU 2018

Q.102 There are two charges $+3\mu\text{C}$ and $+8\mu\text{C}$ the ratio of the force acting on them will be: [ETEA 2018]

- (A) 3:1
- (B) 1:1
- (C) 11:8
- (D) 3:8

Q110.

KMU 2018

Q.103 What is the magnitude of a point charge which produces an electric field of 2 NC^{-1} at a distance of 60 cm? [ETEA 2018]

- (A) $8 \times 10^{-11} \text{ C}$
- (B) $2 \times 10^{-12} \text{ C}$
- (C) $3 \times 10^{-11} \text{ C}$
- (D) $6 \times 10^{-10} \text{ C}$

Q111.

KMU 2018

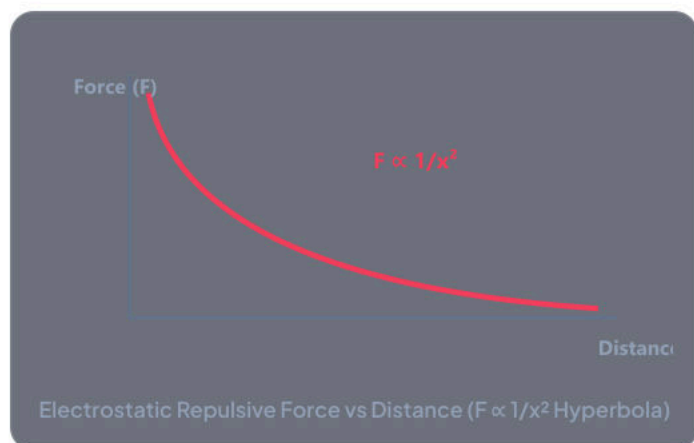
Q.104 The force between two charged bodies is "F". if one of the charge is doubled and the distance between them is halved, the force acting on each charged body is: [ETEA 2018]

- (A) 2F
- (B) 4F
- (C) 8F
- (D) 16F

Q112.

MDCAT 2017

Q.91 A point charge at a distance 'x' from another point charge experiences a force of repulsion, which one of the following graphs shows. How the force is related to 'x': [MDCAT 2017]



- (A) Straight line with negative slope
- (B) Inverse square curve (hyperbola-like decay)
- (C) Straight line with positive slope through origin
- (D) Straight line with negative slope starting from y-axis

Q113.

MDCAT 2017

Q.92 The Coulomb force between two charges $q_1 = 2 \text{ C}$ and q_2 is 2N, the distance between charges is 3m. What is the charge of q_2 ? [MDCAT 2017]

- (A) $1 \times 10^9 \text{ C}$
- (B) $1 \times 10^{-9} \text{ C}$
- (C) $2 \times 10^9 \text{ C}$
- (D) $4 \times 10^{-9} \text{ C}$

Q114.

MDCAT 2017

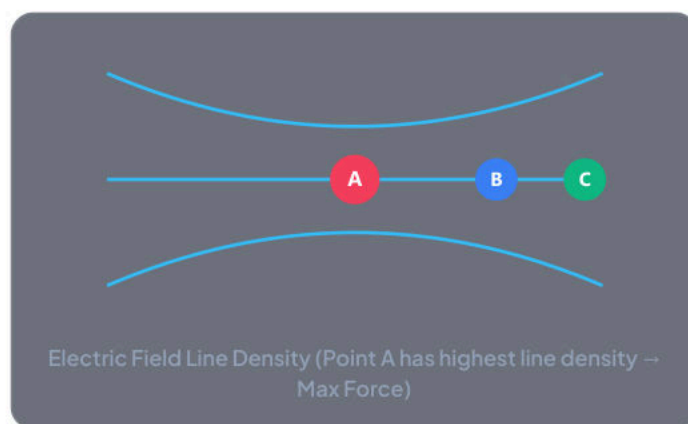
Q.93 The electric field strength at the position $\vec{r} = (4\hat{i} + 3\hat{j}) \text{ m}$ caused by a point charge of $5\mu\text{C}$ placed at origin is [MDCAT 2017]

- (A) $1240\hat{i} + 1280\hat{j} \text{ N/C}$
- (B) $1440\hat{i} + 1080\hat{j} \text{ V/m}$
- (C) $1440\hat{i} + 1080\hat{j} \text{ N/m}$
- (D) $1240\hat{i} + 1080\hat{j} \text{ N/C}$

Q115.

MDCAT 2017

Q.94 If a charge particle is placed one by one at point A, B and C then at which point it will experience a large force: [MDCAT 2017]



- (A) At point "A"
- (B) At point "C"
- (C) At point "B"
- (D) Same at all point

Q116.

KMU 2017

Q.95 The potential of the two plates of a capacitor are +10V and -10V. The charge on one of the plates is 40C. The capacitance of the capacitor is: [ETEA 2017]

- (A) 2F
- (B) 4F
- (C) 0.5 F
- (D) 0.25 F

Q117.

KMU 2017

Q.96 The ratio of the electric force between two protons to that between two electrons is of the order of: [ETEA 2017]

- (A) 10^{42}
- (B) 10^{39}
- (C) 10^{36}
- (D) 1

Q118.

MDCAT 2016

Q.89 If the length, width and separation between the plates of a parallel plate capacitor is doubled then its capacitance becomes [MDCAT 2016]

- (A) Double
- (B) Half
- (C) Four time
- (D) Eight time

Q119.

KMU 2016

Q.90 A charged capacitor stores 10C at 40V. Its stored energy is: [ETEA 2016]

- (A) 400J
- (B) 4J
- (C) 0.2 J
- (D) 200 J

Q120.

KMU 2015

Q.88 The unit of the electric field is: [ETEA 2015]

- (A) N/C
- (B) V/m
- (C) J/C.m
- (D) All of the above

Q121.

MDCAT 2014

Q.85 The distance between the plates of a parallel plate capacitor is 2.0 mm and area of each plates is 2.0 m^2 . A potential difference of $1.0 \times 10^{-4} \text{ V}$ is applied across the plates. Find the capacitance. [MDCAT 2014]

- (A) $4 \times 10^4 \text{ F}$
- (B) $3.54 \times 10^{-10} \text{ F}$
- (C) $8.85 \times 10^{-9} \text{ F}$
- (D) $9.0 \times 10^{-6} \text{ F}$

Q122.

KMU 2014

Q.86 The direction indicated by an electric field line is: [ETEA 2014]

- (A) The potential must increase
- (B) The potential must decrease
- (C) The electric field strength must increase
- (D) The electric field strength must decrease

Q123.

KMU 2014

Q.87 The potential difference between a pair of similar parallel conducting plates is known. What additional information is needed in order to find the electric field strength between the plates? [ETEA 2014]

- (A) Separation of the plates
- (B) Separation and area of the plates
- (C) Permittivity of the medium separation of the plates
- (D) Permittivity of the medium separation and area of plates

Q124.

MDCAT 2013

Q.84 What is the charge stored on a $5\mu\text{F}$ capacitor charged to the potential difference of 12V? [MCAT 2013]

- (A) $60\mu\text{C}$
- (B) 2.4 C
- (C) $2.4\mu\text{C}$
- (D) 60 C

Q125.

MDCAT 2012

Q.82 10 V potential difference is applied across the plates of 1 F capacitor. What is the energy stored in capacitor? [MCAT 2012]

- (A) 0.5 mJ
- (B) 0.05 mJ
- (C) 5 J
- (D) 50 J

Q126.

MDCAT 2012

Q.83 What will be the effect on the capacitance of a capacitor if area of each plate is doubled with separation between the plates is halved? [MCAT 2012]

- (A) Capacitance remains same
- (B) Capacitance becomes double
- (C) Capacitance becomes four times
- (D) Capacitance reduces of half

Q127.

KMU 2011

Q.81 The capacitor which charges and discharges quickly will have [ETEA 2011]

- (A) Small value of RC
- (B) Large value of RC
- (C) Large value of time constant
- (D) None of these

Q128.

MDCAT 2010

Q.79 Electric intensity is a vector quantity and its direction is [MCAT 2010]

- (A) Perpendicular to the direction of field
- (B) Opposite to the direction of force
- (C) At a certain angle
- (D) Along the direction of force

Q129.

MDCAT 2010

Q.80 The magnitude of an electric field between two separated plates can be calculated by the relation [MCAT 2010]

- (A) $\Delta V = Ed$
- (B) $\Delta V = E/d$
- (C) $\Delta V = q_0 d$
- (D) $E = \Delta V$

Q130.

MDCAT 2009

Q.77 A particle carrying charge of $2e$ falls through a potential difference of 3.0 V. Calculate the energy required by it: [MCAT 2009]

- (A) 9.6×10^{-19} J
- (B) 9.1×10^{-19} J
- (C) 1.6×10^{-19} J
- (D) 6.0×10^{-19} J

Q131.

MDCAT 2009

Q.78 The work done in moving a unit positive charge from one point to another point against the electric field is a measure of: [MCAT 2009]

- (A) Capacitance
- (B) Potential difference between two points
- (C) Intensity of electric field
- (D) Resistance between two points

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 08. Electrostatics.

beambeprep.com

Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	A	SZABMU 2024	28	B	BUMHS 2024	55	A	DUHS 2023	82	D	DUHS 2022	109	B	KMU 2018
2	D	SZABMU 2024	29	A	BUMHS 2024	56	C	DUHS 2023	83	C	DUHS 2022	110	A	KMU 2018
3	D	SZABMU 2024	30	B	UHS 2023	57	A	DUHS 2023	84	A	NUMS 2022	111	C	KMU 2018
4	D	SZABMU 2024	31	B	UHS 2023	58	B	NUMS 2023	85	C	NUMS 2022	112	B	MDCAT 2017
5	D	SZABMU 2024	32	C	UHS 2023	59	A	NUMS 2023	86	A	NUMS 2022	113	B	MDCAT 2017
6	D	SZABMU 2024	33	B	UHS 2023	60	C	NUMS 2023	87	A	PMDC 2021	114	B	MDCAT 2017
7	A	SZABMU 2024	34	D	UHS 2023	61	B	UHS 2022	88	C	PMDC 2021	115	A	MDCAT 2017
8	A	KU 2024	35	A	UHS 2023	62	C	UHS 2022	89	B	PMDC 2021	116	A	KMU 2017
9	A	KU 2024	36	C	UHS 2023	63	D	UHS 2022	90	C	PMDC 2021	117	D	KMU 2017
10	A	KU 2024	37	B	SZABMU 2023	64	C	UHS 2022	91	C	PMDC 2021	118	A	MDCAT 2016
11	D	KU 2024	38	A	SZABMU 2023	65	D	UHS 2022	92	A	PMDC 2021	119	D	KMU 2016
12	A	KU 2024	39	D	SZABMU 2023	66	A	UHS 2022	93	B	PMDC 2021	120	D	KMU 2015
13	C	KU 2024	40	B	SZABMU 2023	67	B	UHS 2022	94	D	PMDC 2021	121	C	MDCAT 2014
14	D	KU 2024	41	D	SZABMU 2023	68	C	SZABMU 2022	95	C	PMDC 2020	122	B	KMU 2014
15	C	KU 2024	42	A	SZABMU 2023	69	D	SZABMU 2022	96	C	PMDC 2020	123	A	KMU 2014
16	B	UHS 2024	43	B	SZABMU 2023	70	A	SZABMU 2022	97	C	PMDC 2020	124	A	MDCAT 2013
17	B	UHS 2024	44	D	KMU 2023	71	A	SZABMU 2022	98	A	PMDC 2020	125	D	MDCAT 2012
18	B	UHS 2024	45	D	KMU 2023	72	A	SZABMU 2022	99	A	NUMS 2020	126	C	MDCAT 2012
19	C	UHS 2024	46	D	KMU 2023	73	B	KMU 2022	100	D	NUMS 2020	127	A	KMU 2011
20	B	UHS 2024	47	A	KMU 2023	74	A	KMU 2022	101	C	MDCAT 2019	128	D	MDCAT 2010
21	C	UHS 2024	48	C	KMU 2023	75	B	BUMHS 2022	102	C	MDCAT 2019	129	A	MDCAT 2010
22	D	NUMS 2024	49	C	KMU 2023	76	B	BUMHS 2022	103	D	MDCAT 2019	130	A	MDCAT 2009
23	A	NUMS 2024	50	C	KMU 2023	77	B	BUMHS 2022	104	D	MDCAT 2018	131	B	MDCAT 2009
24	D	NUMS 2024	51	A	DUHS 2023	78	B	DUHS 2022	105	B	MDCAT 2018			
25	D	NUMS 2024	52	D	DUHS 2023	79	D	DUHS 2022	106	B	MDCAT 2018			
26	D	BUMHS 2024	53	C	DUHS 2023	80	C	DUHS 2022	107	D	MDCAT 2018			
27	B	BUMHS 2024	54	B	DUHS 2023	81	B	DUHS 2022	108	A	KMU 2018			

TOTAL
MCQS
131

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (A)

SZABMU 2024

Q.178 The electric flash attachment to a camera contains a capacitor for storing the energy used to produce th...

1.

CORE CONCEPT AND DERIVATION

The total electrical potential energy stored in a charged capacitor can be found using its static capacitance and the applied voltage.

2. Formula:

$$U = \frac{1}{2}CV^2$$

3. Solution:

- Given capacitance: $C = 20 \text{ F}$.
- Given voltage: $V = 5 \text{ V}$.
- Square the voltage: $5^2 = 25$.
- Substitute values: $U = \frac{1}{2}(20)(25)$.
- Calculate: $U = 10 \times 25 = 250 \text{ J}$.

4. Why other options are incorrect:

Option C (500 J) happens if you forget to include the $\frac{1}{2}$ coefficient in the energy formula. Options B and D are arbitrary distractors.

Question #2 Key: (D)

SZABMU 2024

Q.179 Electron-volt is the unit of [SZABMU 2024]

1.

CORE CONCEPT AND DERIVATION

An electron-volt (eV) describes the work done (or kinetic energy gained) when a single electron is accelerated through a potential difference of exactly one volt.

2. Formula:

$$W = q\Delta V \implies 1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

3. Solution:

- Because it equates directly to a tiny fraction of a Joule, it is fundamentally a unit of Energy, heavily used in atomic and particle physics.

4. Why other options are incorrect:

Charge is measured in Coulombs. Current is measured in Amperes. Electric potential is measured in Volts. The 'volt' in the name often tricks students into guessing Option C.

Question #3 Key: (D)

SZABMU 2024

Q.180 Which one of the following is the unit of electric field intensity? [SZABMU 2024]

1.

CORE CONCEPT AND DERIVATION

Electric field intensity can be measured either by the mechanical force it exerts on a charge or by the spatial gradient of its electric potential.

2. Formula:

$$E = \frac{F}{q} = \frac{\Delta V}{\Delta r}$$

3. Solution:

- Using the potential gradient definition ($\Delta V / \Delta r$), the unit naturally becomes Volts (for potential) divided by meters (for distance).

4. Why other options are incorrect:

Newton per Coulomb (N/C) is correct, but Newton per Volt or Ampere are dimensionally nonsensical for an electric field. Volt per Coulomb represents Energy per Charge squared.

Question #4 Key: (D)

SZABMU 2024

Q.181 The SI-unit of relative permittivity is/has [SZABMU 2024]

1.

CORE CONCEPT AND DERIVATION

Relative permittivity (often called the dielectric constant, ϵ_r) is defined as the ratio of a material's absolute permittivity to the absolute permittivity of a perfect vacuum.

2. Formula:

$$\epsilon_r = \frac{\epsilon_{\text{medium}}}{\epsilon_0}$$

3. Solution:

- Because you are mathematically dividing a value by another value with the exact same SI units (F/m/F/m), the units perfectly cancel out.
- This renders relative permittivity a pure, dimensionless scalar ratio.

4. Why other options are incorrect:

Option A is the correct unit for the absolute permittivity of free space (ϵ_0), not the relative ratio. Options B and C are incorrect mathematical variations.

Question #5 Key: (D)

SZABMU 2024

Q.182 The electrostatic force between two point-charges is independent of one of the following quantities? [SZ...

1.

CORE CONCEPT AND DERIVATION

Coulomb's Law provides an exact accounting of the variables required to calculate static electrical force.

2. Formula:

$$F = \frac{1}{4\pi\epsilon} \frac{q_1 q_2}{r^2}$$

3. Solution:

- The equation explicitly requires: Charge magnitudes (q_1, q_2), spatial distance (r), and the medium's permittivity (ϵ).
- Temperature does not appear in the foundational laws of macro-electrostatics and has no bearing on the isolated electrostatic force magnitude between two points.

4. Why other options are incorrect:

Distance, magnitude, and the intervening medium are the literal three pillars that define Coulomb's Law. Changing any of them will drastically alter the force.

Question #6 Key: (D)

SZABMU 2024

Q.183 How many electrons are there in one Coulomb charge? [SZABMU 2024]

1.

CORE CONCEPT AND DERIVATION

A Coulomb is a massive macro-scale unit of charge, defined by an aggregate sum of billions of fundamental elementary charges.

2. Formula:

$$n = \frac{Q}{e}$$

3. Solution:

- Given total charge $Q = 1 \text{ C}$.
- The charge of a single electron is $e = 1.6 \times 10^{-19} \text{ C}$.
- Divide them: $n = \frac{1}{1.6 \times 10^{-19}}$.
- Calculate: $n = 0.625 \times 10^{19}$.
- Standardize scientific notation: 6.25×10^{18} electrons.

4. Why other options are incorrect:

The other options suffer from decimal placement errors (orders of magnitude). The value 6.25×10^{18} is a universally memorized constant bridging microscopic particles to macroscopic current.

Question #7 Key: (A)

SZABMU 2024

Q.184 The SI-unit of capacitance of capacitor is Farad, it can also be expressed as [SZABMU 2024]

1.

CORE CONCEPT AND DERIVATION

Derived SI units can be unspooled into their fundamental base components using standard physics formulas.

2. Formula:

$$C = \frac{Q}{V} \quad \text{where} \quad Q = It \quad \text{and} \quad V = \frac{W}{Q}$$

3. Solution:

- Start with Farad: $F = \frac{\text{Coulombs (C)}}{\text{Volts (V)}}$.
- Expand Volt ($V = \text{Joules/Coulomb}$): $F = \frac{C}{J/C} = \frac{C^2}{J}$.
- Expand Joule ($J = \text{Newton} \times \text{meter}$): $F = \frac{C^2}{N \cdot m}$.
- Expand Coulomb ($C = \text{Ampere} \times \text{second}$): $F = \frac{(A \cdot s)^2}{N \cdot m} = \frac{A^2 \cdot s^2}{N \cdot m}$.

4. Why other options are incorrect:

Options B, C, and D contain incorrect powers for the Ampere (A) or seconds (s) terms, failing the dimensional analysis derivation.

Question #8 Key: (A)

KU 2024

Q.185 What is the increase in force between two charges if the separation between them is decreased by 50 perc...

1.

CORE CONCEPT AND DERIVATION

Electrostatic force scales according to the inverse square law of the distance separating the two charges.

2. Formula:

$$F \propto \frac{1}{r^2}$$

3. Solution:

- Decreasing the distance by 50 percent means the new distance is exactly half the original: $r' = 0.5r = r/2$.
- Substitute this new distance into the denominator: $F' \propto \frac{1}{(r/2)^2}$.
- Square the term: $F' \propto \frac{1}{r^2/4}$.
- Invert the fraction: $F' = 4 \left(\frac{1}{r^2} \right)$.
- The final force is exactly 4 times the original force.

4. Why other options are incorrect:

Option B (doubling) occurs if you forget to square the distance change. Options C and D are not mathematically possible via the inverse square law for a 50% change.

Question #9 **Key: (A)**

KU 2024

Q.186 According to Coulomb's law, what happens to the electrostatic force between the 2-point charges if the d...

1.

CORE CONCEPT AND DERIVATION

Moving charges further apart weakens their mutual electrostatic interaction following the inverse square law.

2. Formula:

$$F \propto \frac{1}{r^2}$$

3. Solution:

- Let the new distance be $r' = 2r$.
- Plug it into the proportion: $F' \propto \frac{1}{(2r)^2}$.
- Square the coefficient: $F' \propto \frac{1}{4r^2}$.
- The result is $\frac{1}{4}$ of the original mathematical expression, proving the force drops to one-fourth.

4. Why other options are incorrect:

Option B assumes a linear $1/r$ drop-off. Option C falsely assumes force increases with distance. Option D assumes force is completely independent of distance.

Question #10 **Key: (A)**

KU 2024

Q.187 What does one Coulomb represent in terms of charges? [KU 2024]

1.

CORE CONCEPT AND DERIVATION

The SI unit of charge (Coulomb) is actually a derived unit, officially defined through the macroscopic properties of flowing electric current (Amperes) and time.

2. Formula:

$$Q = I \times t$$

3. Solution:

- By standard SI definition, 1 Ampere represents 1 Coulomb of charge flowing past a specific point per second.
- Therefore, multiplying 1 Ampere by 1 second inherently defines exactly 1 Coulomb.

4. Why other options are incorrect:

Options B and C refer to the elementary charge (1.6×10^{-19} C). Option D describes an entirely different mathematical constraint (where $F = k(1)^2/1^2 = 9 \times 10^9$ N, not 1 N).

Question #11 Key: (D)

KU 2024

Q.188 Two points charges, [Formula] and [Formula] are placed at points A and B, respectively, which are separa...

1.

CORE CONCEPT AND DERIVATION

This setup describes a classic electric dipole. Electric potential is a scalar quantity, meaning the potentials from multiple charges simply add algebraically (keeping their positive or negative signs).

2. Formula:

$$V_{net} = V_+ + V_-$$

3. Solution:

- The total distance is $2d$, meaning the midpoint M is exactly distance d away from both charges.
- Potential from positive charge: $V_+ = \frac{k(+5\mu\text{C})}{d}$.
- Potential from negative charge: $V_- = \frac{k(-5\mu\text{C})}{d}$.
- Summing them: $V_{net} = \frac{k(5\mu\text{C})}{d} - \frac{k(5\mu\text{C})}{d} = 0$.

4. Why other options are incorrect:

Options A, B, and C would apply if the question asked for Electric Field intensity (a vector, where the two fields would point in the exact same direction and constructively add together). Potential, being scalar, strictly cancels.

Question #12 Key: (A)

KU 2024

Q.189 In the case of a parallel plate capacitor, when the distance between the two plates is reduced to half a...

1.

CORE CONCEPT AND DERIVATION

The capacitance of a parallel plate setup relies on the ratio of its surface area to its gap distance. Manipulating both variables simultaneously multiplies their respective effects.

2. Formula:

$$C = \frac{\epsilon_0 A}{d}$$

3. Solution:

- Let initial capacitance be $C = \frac{\epsilon_0 A}{d}$.
- The area is doubled: $A' = 2A$.
- The distance is halved: $d' = d/2$.
- Substitute into formula: $C' = \frac{\epsilon_0 (2A)}{d/2}$.
- The denominator's fraction flips up: $C' = 2 \times 2 \left(\frac{\epsilon_0 A}{d} \right) = 4C$.

4. Why other options are incorrect:

Option D occurs if Area is halved and Distance is halved (canceling out). Option C occurs if only Area is doubled, or only Distance is halved. Combining them yields a 4x multiplier.

Question #13 Key: (C)

KU 2024

Q.190 If the dielectric material between the plates of the capacitor is removed, what happens to the electric ...

1.

CORE CONCEPT AND DERIVATION

Assuming the charged capacitor is isolated (disconnected from a battery), removing the dielectric removes the internal opposing polarization field. Thus, the total net field rebounds to its original vacuum strength.

2. Formula:

$$E_{vac} = E_{med} \times \epsilon_r$$

3. Solution:

- While the dielectric was inserted, the electric field was suppressed ($E_{med} = E_{vac}/\epsilon_r$).
- Removing the dielectric means ϵ_r effectively returns to 1.
- Because the trapped charge Q cannot escape, the lack of polarization mathematically forces the net electric field E to instantly increase back to its undamped vacuum state.

4. Why other options are incorrect:

Option B is exactly what happens when you *insert* the dielectric. Option D assumes the dielectric had no physical effect at all.

Question #14 Key: (D)

KU 2024

Q.191 Capacitance of a capacitor increases with decrease in: [KU 2024]

1.

CORE CONCEPT AND DERIVATION

Capacitance relies on the geometric inverse proportionality between storage capability and the distance isolating the oppositely charged plates.

2. Formula:

$$C = \frac{\epsilon A}{d}$$

3. Solution:

- Because separation distance (d) resides strictly in the denominator, decreasing its value mathematically forces the total value of C to grow larger.
- Physically, pushing the plates closer increases the mutual attraction between opposite charges, allowing the plates to hold more total charge at the same voltage.

4. Why other options are incorrect:

Decreasing Dielectric constant, Permittivity, or Plate Area (all numerator variables) would strictly cause the Capacitance to actively decrease.

Question #15 Key: (C)

KU 2024

Q.192 Electron Volt (eV) is another unit of [KU 2024]

1.

CORE CONCEPT AND DERIVATION

An electron-volt is a localized unit representing the kinetic energy an electron gains when accelerated through a one-volt field.

2. Formula:

$$W = q\Delta V$$

3. Solution:

- Charge $\times$ Voltage = Joules.
- Since an electron-volt directly maps to 1.6×10^{-19} Joules, it is inherently a measurement of Energy.

4. Why other options are incorrect:

Charge is Coulombs. Current is Amperes. Power is Watts (Energy over time). The presence of the word "Volt" often misleads students into associating it with potential rather than energy.

Question #16 Key: (B)

UHS 2024

Q.193 Which one of the following is NOT a feature of electric forces? [UHS 2024]

1.

CORE CONCEPT AND DERIVATION

Electrostatic forces are a fundamental interaction strictly governed by the property of electric charge, entirely independent of the object's mass.

2. Formula:

$$F_E = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- The formula for electric force dictates that objects must possess a non-zero charge (q) to interact electrostatically.
- Gravitational forces act on masses. Electric forces inherently do not care about mass; a massive uncharged neutron feels exactly zero electric force.

4. Why other options are incorrect:

Options A, C, and D accurately describe the literal defining traits of electric forces: they require charges, and unlike gravity, they possess dual polarity (both attraction and repulsion).

Question #17 Key: (B)

UHS 2024

Q.194 Find potential difference in moving 2 C charge which requires 600 J of work between two points. [UHS 202...]

1.

CORE CONCEPT AND DERIVATION

Voltage (potential difference) strictly quantifies the amount of energy or work required to relocate a singular unit of charge.

2. Formula:

$$V = \frac{W}{q}$$

3. Solution:

- Identify total work: $W = 600 \text{ J}$.
- Identify total charge: $q = 2 \text{ C}$.
- Divide them: $V = \frac{600}{2} = 300 \text{ Volts}$.

4. Why other options are incorrect:

Option A comes from multiplying 600×2 . Option C might arise from an extra unneeded division by 2. Option D comes from 600×4 .

Question #18 Key: (B)

UHS 2024

Q.195 Electric intensity between two oppositely charge plates in the middle region is [UHS 2024]

1.

CORE CONCEPT AND DERIVATION

Deep inside the central gap of a parallel plate capacitor (ignoring the bulging 'fringing' effects at the far edges), the electric field lines run perfectly parallel and equally spaced.

2. Formula:

$$E = \frac{V}{d} = \text{Constant}$$

3. Solution:

- Because the field lines do not compress or expand in the central region, the electric intensity remains perfectly uniform at every geometric point between the plates.

4. Why other options are incorrect:

Non-uniform or Variable behavior only occurs strictly near the edges of the plates, or if the plates themselves are warped and non-parallel.

Question #19 Key: (C)

UHS 2024

Q.196 The S.I unit of capacitance of a capacitor is: [UHS 2024]

1.

CORE CONCEPT AND DERIVATION

The International System of Units specifies a single derived unit to quantify how much electrical charge a device can store per volt of potential.

2. Formula:

$$1 \text{ F} = 1 \text{ C/V}$$

3. Solution:

- The standard unit assigned to capacitance is the Farad (F).

4. Why other options are incorrect:

Coulomb is the unit for electrical charge. Volt is the unit for electrical potential difference. Ampere is the unit for electrical current.

Question #20 **Key: (B)**

UHS 2024

Q.197 The Coulomb's law states [UHS 2024]

1.

CORE CONCEPT AND DERIVATION

Coulomb's Law defines two distinct relationships: a numerator driving force magnitude up (charge), and a denominator driving it down exponentially (distance).

2. Formula:

$$F = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- The formula states force is "directly proportional" to the numerator (the mathematical product of q_1 and q_2).
- The formula states force is "inversely proportional" to the denominator (the spatial square of the distance r^2).
- Statement B maps perfectly to this mathematical reality.

4. Why other options are incorrect:

Option A flips the numerator and denominator relationships. Option C falsely claims the charges are added (sum) rather than multiplied (product). Option D claims force scales up with distance, which is entirely false.

Question #21 **Key: (C)**

UHS 2024

Q.198 The formula [Formula] represents [UHS 2024]

1.

CORE CONCEPT AND DERIVATION

Work done per unit charge forms the foundational definition for the voltage generated by a static field.

2. Formula:

$$V = \frac{W}{q_0}$$

3. Solution:

- By defining V as Joules (Work) per Coulomb (Charge), this equation specifically defines Electric Potential at a given point in space.

4. Why other options are incorrect:

Electric intensity is F/q . Electric power is W/t . Electric field gradient is $\Delta V/\Delta r$.

Question #22 **Key: (D)**

NUMS 2024

Q.199 Capacitor cannot be fully charge because time required to charge [NUMS 2024]

1.

CORE CONCEPT AND DERIVATION

The charging curve of a capacitor in a standard DC circuit follows an asymptotic exponential growth function.

2. Formula:

$$Q(t) = Q_{max} \left(1 - e^{-t/RC} \right)$$

3. Solution:

- As the capacitor fills, the opposing voltage it generates reduces the incoming current.
- Mathematically, the term $e^{-t/RC}$ only truly reaches exactly 0 when time (t) reaches absolute mathematical infinity.
- Thus, while practically it is considered "fully charged" after roughly 5 time constants, theoretically, it requires infinite time.

4. Why other options are incorrect:

At 1 time constant, it is ~63% charged. At 4 time constants, it is ~98% charged. Neither represents a "full" 100% mathematical charge.

Question #23 **Key: (A)**

NUMS 2024

Q.200 At midpoint P $+4\mu\text{C}$ $-4\mu\text{C}$ P At Midpoint P: Potential $V = 0$, Field $E \neq 0$ Electric Dipole Midpoint P ($V = 0, \dots$)

1.

CORE CONCEPT AND DERIVATION

In an electric dipole composed of equal and opposite charges, the midpoint behaves uniquely regarding scalar (potential) and vector (field) quantities.

2. Formula:

$$V_{net} = V_+ + V_- \quad \text{and} \quad \vec{E}_{net} = \vec{E}_+ + \vec{E}_-$$

3. Solution:

- Potential is scalar. Since the distance to the positive charge equals the distance to the negative charge, their potentials sum algebraically to exactly zero: $V_{net} = \frac{kq}{r} - \frac{kq}{r} = 0$.
- Electric field is a vector. The positive charge pushes a positive test charge right. The negative charge pulls that same test charge right. The vectors constructively add together, meaning the total field is non-zero ($E \neq 0$).

4. Why other options are incorrect:

Option B assumes the fields cancel out (which only happens between two identical like-charges). Options C and D assume the scalar potential fails to cancel.

Question #24 Key: (D)

NUMS 2024

Q.201 A particle have a charge of 1C falls through a potential difference of 5 V. The energy required by it is...

1.

CORE CONCEPT AND DERIVATION

The energy gained or work done on a massive charge accelerating through an electrostatic potential is the basic product of the charge and voltage.

2. Formula:

$$E = q\Delta V$$

3. Solution:

- Identify total charge: $q = 1 \text{ C}$.
- Identify voltage: $V = 5 \text{ V}$.
- Substitute and multiply natively: $E = 1 \times 5 = 5 \text{ Joules}$.

4. Why other options are incorrect:

Options A and B attempt to trick the student into using the charge of a single electron ($1.6 \times 10^{-19} \text{ C}$) instead of the explicitly stated 1 Coulomb macro-charge. Option C adds the values rather than multiplying.

Question #25 Key: (D)

NUMS 2024

Q.202 If the value of electric field intensity between the plates increases two times then energy stored in a ...

1.

CORE CONCEPT AND DERIVATION

The total electrical energy stored entirely within a region of space is dictated by its energy density, which scales with the square of the local electric field.

2. Formula:

$$U = \frac{1}{2} \epsilon_0 E^2 (A \cdot d)$$

3. Solution:

- The energy equation proves that potential energy (U) is directly proportional to the square of the electric field intensity (E^2).
- If the new field is $2E$, substituting it yields $(2E)^2 = 4E^2$.
- The entire system's total stored energy increases by a factor of 4, quadrupling.

4. Why other options are incorrect:

Option A assumes a false linear relationship ($U \propto E$). Options B and C describe mathematically inverse relationships that apply to distance, not field strength.

Question #26 **Key: (D)**

BUMHS 2024

Q.203 A fully charged capacitor with charge q and capacitance C is connected across a resistor R in series. Po...

1.

CORE CONCEPT AND DERIVATION

During the discharge of a capacitor through a resistor, the outgoing current drops exponentially over time. Power dissipation requires current.

2. Formula:

$$P = I^2 R \quad \text{where} \quad I(t) = I_0 e^{-t/RC}$$

3. Solution:

- Because current decays according to the asymptotic function $e^{-t/RC}$, the current only reaches exactly zero mathematically when $t \rightarrow \infty$.
- Since Power strictly relies on Current ($P = I^2 R$), power dissipation only truly halts at mathematical infinity, despite being practically negligible much earlier.

4. Why other options are incorrect:

At $t = 0$, power dissipation is at its absolute maximum. At $1 RC$ and $5 RC$, current is still flowing (approx 37% and 1% of max current remain, respectively), meaning power is still being dissipated.

Question #27 **Key: (B)**

BUMHS 2024

Q.204 A dielectric for a capacitor can be I. polar II. non-polar [BUMHS 2024]

1.

CORE CONCEPT AND DERIVATION

Dielectric insulators are classified by the natural state of their molecules, but both types successfully polarize and function perfectly inside a capacitor.

2. Formula:

$$P_{total} = P_{orientation} + P_{electronic}$$

3. Solution:

- Polar dielectrics (like water) have molecules with permanent dipole moments that physically rotate to align with the external field.
- Non-polar dielectrics (like air or rubber) have symmetrical molecules, but the external field distorts their electron clouds, inducing temporary dipoles.
- Both categories successfully generate an opposing internal electric field, fulfilling their role as dielectrics.

4. Why other options are incorrect:

Selecting only I or only II fails to recognize that the fundamental requirement of a dielectric is simply that it is an insulator capable of polarization, regardless of its baseline molecular symmetry.

Question #28 Key: (B)

BUMHS 2024

Q.205 The electric potential at a point in an electric field is the amount of work done to move: [BUMHS 2024]

1.

CORE CONCEPT AND DERIVATION

This is the rigid, standardized textbook definition of absolute electric potential, creating a universal baseline for measurement.

2. Formula:

$$V = \frac{W_{\infty \rightarrow r}}{q_0}$$

3. Solution:

- To define "absolute" potential, the starting location must have precisely zero potential, which only occurs at an infinite spatial distance ($r = \infty$).
- By long-standing physics convention, we normalize this work by standardizing it against a "unit positive test charge" (+1 C).

4. Why other options are incorrect:

Moving 'any amount' of charge defines raw Work, not normalized Potential. Using 'any position' defines Potential Difference (ΔV), not absolute potential. Standard convention prohibits using a negative test charge.

Question #29 Key: (A)

BUMHS 2024

Q.206 A spherical liquid drop has a diameter of 2cm and is given a charge of 1mC. The potential at the surface...

1.

CORE CONCEPT AND DERIVATION

The electric potential at the direct surface of a charged conducting sphere behaves identically to a point charge mathematically located at the sphere's absolute center.

2. Formula:

$$V = \frac{kQ}{r}$$

3. Solution:

- Given diameter = 2 cm. Therefore, radius $r = 1 \text{ cm} = 0.01 \text{ m} = 10^{-2} \text{ m}$.
- Given charge $Q = 1 \text{ mC} = 1 \times 10^{-3} \text{ C}$.
- Coulomb's constant $k = 9 \times 10^9$.
- Substitute: $V = \frac{(9 \times 10^9)(1 \times 10^{-3})}{10^{-2}}$.
- Calculate numerator: 9×10^6 .
- Bring up the denominator's exponent: $V = 9 \times 10^6 \times 10^2 = 9 \times 10^8 \text{ V}$.
- Convert to MegaVolts ($1 \text{ MV} = 10^6 \text{ V}$): $900 \times 10^6 \text{ V} = 900 \text{ MV}$.

4. Why other options are incorrect:

Options C and D mistakenly utilize the full 2cm diameter instead of halving it for the radius. Option B suffers from a massive scientific notation decimal error.

Question #30 **Key: (B)**

UHS 2023

Q.147 A capacitor of capacitance 'C' has a charge 'Q' and stored energy is 'W'. If the charge is increased to ...

1.

CORE CONCEPT AND DERIVATION

The energy within a capacitor scales quadratically with the total amount of charge it possesses (provided its physical capacitance remains unchanged).

2. Formula:

$$W = \frac{Q^2}{2C}$$

3. Solution:

- The original stored energy equation is $W = \frac{Q^2}{2C}$.
- When charge is doubled to $2Q$, plug it in: $W' = \frac{(2Q)^2}{2C} = \frac{4Q^2}{2C}$.
- Factoring out the original expression yields $W' = 4 \times W$.

4. Why other options are incorrect:

Option A falsely assumes energy scales linearly with charge ($U \propto Q$). Options C and D represent decreases, which physically contradicts forcing more charge into the plates.

Question #31 **Key: (B)**

UHS 2023

Q.148 To store the electric charge the ultra-capacitors, use ____ effect. [UHS 2023]

1.

CORE CONCEPT AND DERIVATION

Ultracapacitors (or supercapacitors) bridge the gap between traditional dielectric capacitors and batteries by utilizing electrochemical phenomena to achieve massive capacitances.

2. Formula:

$$C = \frac{\epsilon A}{d}$$

3. Solution:

- They achieve immense capacitance by utilizing the 'Electrochemical Double Layer' effect.
- Instead of a solid dielectric, they use a porous electrolyte where charged ions gather incredibly close to the electrodes (down to nanometer distances, drastically shrinking d in the formula).

4. Why other options are incorrect:

Single, Triple, and Quadruple layers are scientifically fabricated distractors. The term of art in chemistry and physics for this specific boundary phenomenon is strictly 'Double Layer'.

Question #32 Key: (C)

UHS 2023

Q.149 What is the potential difference between two points in an electric field if it takes 600J of energy of m...

1.

CORE CONCEPT AND DERIVATION

Potential difference (Voltage) directly measures the energetic 'cost' of forcing a set amount of charge from one location to another.

2. Formula:

$$V = \frac{W}{q}$$

3. Solution:

- Given the total Work (Energy): $W = 600 \text{ J}$.
- Given the total Charge: $q = 2 \text{ C}$.
- Substitute and evaluate: $V = \frac{600}{2} = 300 \text{ V}$.

4. Why other options are incorrect:

Option A involves mathematically multiplying the values instead of dividing. Option D implies moving along an equipotential surface where work is zero.

Question #33 Key: (B)

UHS 2023

Q.150 A charged particle moves in a uniform electric field between two oppositely charged parallel metal plate...

1.

CORE CONCEPT AND DERIVATION

The electrostatic force exerted on a charged particle inside a uniform electric field depends exclusively on the field's geometric parameters and the particle's own charge.

2. Formula:

$$F = qE = q\left(\frac{V}{d}\right)$$

3. Solution:

- Looking at the combined formula, computing Force requires: Particle charge (q), Potential difference (V), and Plate separation (d).
- The particle's dynamic speed is entirely absent from the equations of electrostatics.

4. Why other options are incorrect:

Options A, C, and D are explicit variables within the $F = q(V/d)$ equation, rendering them absolutely necessary for calculation. Speed only matters for magnetic fields ($F = qvB$).

Question #34 **Key: (D)**

UHS 2023

Q.151 Gauss's law cannot be used to find which of the following quantity? [UHS 2023]

1.

CORE CONCEPT AND DERIVATION

Gauss's Law provides a spatial relationship equating the net electric flux leaving a closed volume to the total charge held inside it.

2. Formula:

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$$

3. Solution:

- The law treats the permittivity constant (ϵ_0) as a fundamental prerequisite input, an established property of the universe/medium.
- You manipulate the formula to solve for the field (E), the flux (EA), or the enclosed charge (Q). You cannot "find" permittivity via this macroscopic law.

4. Why other options are incorrect:

The other options are variables algebraically locked into the primary equation, making them all directly solvable if the other parameters are known.

Question #35 **Key: (A)**

UHS 2023

Q.152 Electric field intensity inside a hollow charged sphere is: [UHS 2023]

1.

CORE CONCEPT AND DERIVATION

In electrostatic equilibrium, any net charge placed upon a hollow conducting sphere migrates entirely to its outer exterior surface due to mutual repulsion.

2. Formula:

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$$

3. Solution:

- If we define a Gaussian surface completely inside the hollow cavity of the sphere, the enclosed charge Q_{enc} is exactly zero.
- Since $Q_{enc} = 0$, the integral mathematically dictates that the internal Electric field E must also be exactly zero everywhere inside.

4. Why other options are incorrect:

If the field were maximum, positive, or negative, loose charges inside the metal walls would be continually accelerated, breaking the definition of electrostatic equilibrium.

Question #36 Key: (C)

UHS 2023

Q.153 As per Coulomb's law, the force of attraction or repulsion between two-point charges is directly proport...

1.

CORE CONCEPT AND DERIVATION

Coulomb derived mathematically that the strength of the electrostatic pull or push depends on the multiplied interaction of the two charge magnitudes involved.

2. Formula:

$$F \propto q_1 \times q_2$$

3. Solution:

- The numerator of the Coulomb equation strictly dictates a multiplicative product ($q_1 \cdot q_2$), meaning if you double one charge, the total mutual force doubles for both.

4. Why other options are incorrect:

Option A (sum) is algebraically incorrect. Options B and D refer to the spatial relationship, but force is *inversely* proportional to the square of the distance, not directly.

Question #37 Key: (B)

SZABMU 2023

Q.154 The relative permittivity of air (1 atm) is: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

Relative permittivity (dielectric constant) compares a medium's resistance to forming an electric field against a perfect vacuum.

2. Formula:

$$\epsilon_r = \frac{\epsilon_{\text{medium}}}{\epsilon_0}$$

3. Solution:

- A perfect vacuum is exactly defined as $\epsilon_r = 1.0000$.
- Standard dry air contains sparse gas molecules that polarize very slightly, raising its constant just barely above a vacuum to approximately 1.0006.

4. Why other options are incorrect:

Option A is the strict mathematical value for a pure vacuum. Options C and D represent denser liquid or solid dielectrics, not near-vacuum gases.

Question #38 Key: (A)

SZABMU 2023

Q.155 Equivalent capacitance is less than least value of capacitance in a combination in: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

The mathematical method for summing capacitors in series relies on adding their reciprocals, which guarantees a final value strictly smaller than the smallest individual component.

2. Formula:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$$

3. Solution:

- Because you are adding fractions to form a larger denominator value, inverting that final sum forces the equivalent capacitance (C_{eq}) to shrink below any of the starting values. This effectively widens the total plate separation.

4. Why other options are incorrect:

In Parallel combinations (Option B), the capacitances are directly added ($C_{eq} = C_1 + C_2$), so the equivalent value is always much larger than the largest individual capacitor.

Question #39 Key: (D)

SZABMU 2023

Q.156 The magnitude of the force between two-point charges is directly proportional to: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

Coulomb's Law splits into two proportionalities: direct proportionality to charge interaction, and inverse proportionality to spatial separation.

2. Formula:

$$F = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- The term "directly proportional" refers to the numerator of the equation.
- The numerator is $(q_1 \times q_2)$, representing the mathematical product of the separate charge magnitudes.

4. Why other options are incorrect:

Options A, B, and C reference distance. Force is *inversely* proportional to the square of the distance, not directly.

Question #40 Key: (B)

SZABMU 2023

Q.157 When dielectric is placed between the plates of a capacitor then capacitance will: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

Inserting a dielectric medium allows the capacitor plates to hold more charge at the exact same voltage, fundamentally boosting its storage capacity.

2. Formula:

$$C_{med} = \epsilon_r C_{vac}$$

3. Solution:

- Because the dielectric constant (ϵ_r) of any insulating material is always greater than 1 (vacuum), multiplying the baseline capacitance by ϵ_r guarantees that the final capacitance mathematically increases.

4. Why other options are incorrect:

Decreasing the capacitance (Option A) would occur if you removed the dielectric. The other options contradict standard electrostatic enhancement.

Question #41 Key: (D)

SZABMU 2023

Q.158 A one micro farad capacitor of a TV is subjected to 4000 V potential difference. The energy stored in ca...

1.

CORE CONCEPT AND DERIVATION

High voltages applied across standard capacitors result in significant electrical potential energy accumulation, proportional to the square of the voltage.

2. Formula:

$$U = \frac{1}{2}CV^2$$

3. Solution:

- Identify Capacitance: $C = 1\mu\text{F} = 1 \times 10^{-6} \text{ F}$.
- Identify Voltage: $V = 4000 \text{ V} = 4 \times 10^3 \text{ V}$.
- Square the voltage: $V^2 = (4 \times 10^3)^2 = 16 \times 10^6$.
- Substitute: $U = \frac{1}{2}(1 \times 10^{-6})(16 \times 10^6)$.
- The positive and negative exponents cancel perfectly ($10^{-6} \times 10^6 = 1$).
- Calculate final value: $U = \frac{1}{2} \times 16 = 8 \text{ Joules}$.

4. Why other options are incorrect:

Option A forgets the 1/2 coefficient. Options B and C arise from failure to square the voltage correctly or from mishandling the scientific notation prefixes.

Question #42 Key: (A)

SZABMU 2023

Q.159 A particle carrying a charge $2e$ falls through a P.D of 3 V. The energy acquired will be: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

The electron-volt (eV) unit system bypasses the need for massive Coulombs conversions. The energy in eV is simply the numerical number of elementary charges multiplied by the potential difference.

2. Formula:

$$E(\text{in eV}) = q(\text{in } e) \times V$$

3. Solution:

- Charge of the particle: $q = 2e$ (it has two elementary charges, like an alpha particle or divalent ion).
- Voltage drop: $V = 3 \text{ V}$.
- Multiply them natively: $E = 2e \times 3 \text{ V} = 6 \text{ eV}$.

4. Why other options are incorrect:

Option D represents adding the numbers (3+2). Option C represents dividing the numbers (3/2). Both represent fundamental algebraic misunderstandings of the energy relationship.

Question #43 Key: (B)

SZABMU 2023

Q.160 Due to polarization process of dielectric, the electric intensity: [SZABMU 2023]

1.

CORE CONCEPT AND DERIVATION

When placed in an external electric field, the atoms inside a dielectric shift. Positive nuclei pull slightly one way, electron clouds the other. This creates a weak 'internal' field pointing backward, fighting the main field.

2. Formula:

$$E_{net} = E_{external} - E_{internal}$$

3. Solution:

- Because the newly created internal polarization field acts in direct opposition to the primary external field, their vector sum forces the overall net electric intensity inside the material to actively decrease.

4. Why other options are incorrect:

It does not become fully zero (Option D) unless the material is a perfect conductor that shifts free electrons until total cancellation occurs. Dielectrics only partially cancel the field.

Question #44 Key: (D)

KMU 2023

Q.161 Two charges of magnitude [Formula] and [Formula], are separated at a distance [Formula] apart, the rati...

1.

CORE CONCEPT AND DERIVATION

Newton's Third Law of Motion strictly dictates that all forces are mutual interactions. An electrostatic force is a shared bond between two objects.

2. Formula:

$$F_1 = F_2 = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- Despite q_2 being five times larger in magnitude than q_1 , the actual force formula multiplies them together.
- The force q_1 feels is $k(1)(5)/r^2$.
- The force q_2 feels is $k(5)(1)/r^2$.
- Both forces are mathematically identical, making their ratio perfectly 1:1.

4. Why other options are incorrect:

Option A attempts to bait students into comparing the ratio of the charges themselves, rather than the mutual forces they experience.

Question #45 Key: (D)

KMU 2023

Q.162 Two equal and opposite charges of 10C are separated at a distance of 10 cm, the electric potential at mi...

1.

CORE CONCEPT AND DERIVATION

Electric potential is a scalar quantity, not a vector. To find total potential at a point, you simply add the algebraic values of the potentials from all nearby charges.

2. Formula:

$$V_{net} = V_+ + V_-$$

3. Solution:

- At the exact midpoint, the distance to the positive charge is r and the distance to the negative charge is an identical r .
- The positive charge creates a potential of $V_+ = +\frac{kq}{r}$.
- The negative charge creates a potential of $V_- = -\frac{kq}{r}$.
- Because they are identical in magnitude but opposite in sign, their algebraic sum evaluates to precisely 0 V.

4. Why other options are incorrect:

If this question asked for Electric Field (a vector), the fields would reinforce and add together. But for Potential, opposite signs flawlessly cancel out.

Question #46 Key: (D)

KMU 2023

Q.163 The force of repulsion between two alike charges is 10N in vacuum. When a material of [Formula] is place...

1.

CORE CONCEPT AND DERIVATION

Inserting a dielectric material between two free charges shields them from each other, dampening the electrostatic interaction force between them.

2. Formula:

$$F_{medium} = \frac{F_{vacuum}}{\epsilon_r}$$

3. Solution:

- Original force in vacuum: $F_{vac} = 10 \text{ N}$.
- Dielectric constant of new medium: $\epsilon_r = 2$.
- Substitute and divide: $F_{med} = \frac{10}{2} = 5 \text{ N}$.

4. Why other options are incorrect:

Option A results from multiplying the force by the dielectric constant (which increases Capacitance, but always decreases Force).

Question #47 Key: (A)

KMU 2023

Q.164 The slope of the charge-time graph for a charging capacitor gives: [ETEA 2023]

1.

CORE CONCEPT AND DERIVATION

In physics, the slope of any graph is strictly defined by the change in the y-axis divided by the change in the x-axis.

2. Formula:

$$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{\Delta Q}{\Delta t}$$

3. Solution:

- The y-axis represents Charge (Q), and the x-axis represents Time (t).
- The mathematical rate of flow of charge over time ($\Delta Q / \Delta t$) is the fundamental definition of Electric Current (I).

4. Why other options are incorrect:

Voltage relates charge to capacitance ($V = Q/C$). Energy relates charge to voltage ($U = \frac{1}{2}QV$). Only current involves a time derivative.

Question #48 Key: (C)

KMU 2023

Q.165 Two small charged objects attract each other with a force F when separated by a distance d . If the charge...

1.

CORE CONCEPT AND DERIVATION

The electrostatic force relies on the multiplied product of both interacting charges. Changing either charge individually affects the final total force.

2. Formula:

$$F = k \frac{q_1 q_2}{d^2}$$

3. Solution:

- Original force: $F = k(q)(q)/d^2$.
- Both charges are individually halved, becoming $q/2$.
- Substitute new charges: $F' = k \frac{(q/2)(q/2)}{d^2}$.
- Pull out the fractions: $F' = \frac{1}{4} \left(k \frac{q_1 q_2}{d^2} \right)$.
- The resulting force is exactly $F/4$.

4. Why other options are incorrect:

Option D occurs if only one of the charges is halved. Option A would occur if the distance was also accidentally doubled alongside the charge reductions.

Question #49 Key: (C)

KMU 2023

Q.166 If both the plate area and the plate separation of a parallel-plate capacitor are doubled, the capacitance...

1.

CORE CONCEPT AND DERIVATION

Capacitance geometry relies on a ratio. Altering the top and bottom of that ratio identically results in perfect mathematical cancellation.

2. Formula:

$$C = \frac{\epsilon_0 A}{d}$$

3. Solution:

- The original capacitance is $C = \frac{\epsilon_0 A}{d}$.
- The area is doubled: $A' = 2A$.
- The separation is doubled: $d' = 2d$.
- Substitute: $C' = \frac{\epsilon_0 (2A)}{2d}$.
- The '2' in the numerator perfectly cancels the '2' in the denominator, leaving $C' = C$, meaning the net capacitance remains entirely unchanged.

4. Why other options are incorrect:

Capacitance would double if only Area was doubled. It would halve if only Separation was doubled. Modifying both identically nullifies the change.

Question #50 Key: (C)

KMU 2023

Q.167 A [Formula] capacitor is charged to 200 V, its stored energy is: [ETEA 2023]

1.

CORE CONCEPT AND DERIVATION

The electrical energy stored dynamically within a capacitor's field is proportional to the square of its voltage.

2. Formula:

$$U = \frac{1}{2} CV^2$$

3. Solution:

- Identify Capacitance: $C = 20 \mu\text{F} = 20 \times 10^{-6} \text{ F}$.
- Identify Voltage: $V = 200 \text{ V} = 2 \times 10^2 \text{ V}$.
- Square the voltage: $V^2 = (200)^2 = 40000 = 4 \times 10^4$.
- Substitute: $U = \frac{1}{2} (20 \times 10^{-6}) (4 \times 10^4)$.
- Calculate: $U = 10 \times 10^{-6} \times 4 \times 10^4 = 40 \times 10^{-2}$.
- Simplify: $40 \times 10^{-2} = 0.4 \text{ Joules}$.

4. Why other options are incorrect:

Option A incorrectly ignores the micro (10^{-6}) unit conversion prefix. Option B misses a decimal place order of magnitude shift.

Question #51 Key: (A)

DUHS 2023

Q.168 The change in electric potential with respect to distance equals to: [SINDH 2023]

1.

CORE CONCEPT AND DERIVATION

In physics, any quantity's mathematical "rate of change with respect to distance" is referred to as its spatial gradient.

2. Formula:

$$E = -\frac{\Delta V}{\Delta r}$$

3. Solution:

- The term $\Delta V / \Delta r$ evaluates how steeply the voltage drops off as you move through space.
- This specific mathematical construct is formally titled the "Potential Gradient," and it is strictly equivalent to the magnitude of the Electric Field.

4. Why other options are incorrect:

Potential difference is just ΔV without dividing by distance.
Surface charge density is charge per unit area (Q/A).

Question #52 Key: (D)

DUHS 2023

Q.169 The amount of energy required in moving an electron of charge (e) by the application of 1volt potential ...

1.

CORE CONCEPT AND DERIVATION

This question is literally stating the textbook definition of the electron-volt unit, a standard energy metric used heavily in quantum mechanics and particle physics.

2. Formula:

$$E = q\Delta V$$

3. Solution:

- When q equals exactly 1 fundamental electron charge ($1e$).
- And ΔV equals exactly 1 Volt.
- The mathematical result is $1e \times 1V = 1 \text{ eV}$ (One electron-volt).

4. Why other options are incorrect:

The other options include metric prefixes: kilo (1000 eV), Mega (1,000,000 eV), and Giga (1,000,000,000 eV), which apply to much higher energy particle accelerators, not a simple 1-volt drop.

Question #53 Key: (C)

DUHS 2023

Q.170 Which law explains the relation between amount of charges and force between them? [SINDH 2023]

1.

CORE CONCEPT AND DERIVATION

Charles-Augustin de Coulomb formulated the foundational electrostatic law that quantifies the exact force between two stationary, electrically charged particles.

2. Formula:

$$F = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- Coulomb's equation directly bridges the gap between measuring static charge magnitude and measuring dynamic mechanical force.

4. Why other options are incorrect:

Ohm's law bridges Voltage and Current in circuits. Lenz's law dictates the direction of induced magnetic currents. Ampere's law equates magnetic fields to wire currents.

Question #54 Key: (B)

DUHS 2023

Q.171 What does the electric field around a charge represent? [SINDH 2023]

1.

CORE CONCEPT AND DERIVATION

Historically, an electric field is described as an invisible 'sphere of influence' permeating the space surrounding a source charge.

2. Formula:

$$\vec{F} = q_0 \vec{E}$$

3. Solution:

- The field dictates the strict geographic "effective area" (or more accurately, the 3D volume) within which another charged particle will successfully "feel" an electrostatic pushing or pulling force.

4. Why other options are incorrect:

The field does not represent physical size (Option A). Field lines *can* imply a path, but the field itself represents the force capability, not the motion (Option C). Electrostatics explicitly ignores speed (Option D).

Question #55 **Key: (A)**

DUHS 2023

Q.172 1 N/C equals to [SINDH 2023]

1.

CORE CONCEPT AND DERIVATION

The standard unit of Electric Field Intensity can be mathematically proven via two separate defining equations (Force vs Gradient) to be entirely interchangeable.

2. Formula:

$$E = \frac{F}{q} \Rightarrow \text{N/C} \quad \text{and} \quad E = \frac{V}{d} \Rightarrow \text{V/m}$$

3. Solution:

- Start with Volts per meter (V/m).
- Expand Volt into Joules per Coulomb (J/C): $\frac{\text{J/C}}{\text{m}} = \frac{\text{J}}{\text{C}\cdot\text{m}}$.
- Expand Joule into Newton-meters (N·m): $\frac{\text{N}\cdot\text{m}}{\text{C}\cdot\text{m}}$.
- The meters mutually cancel, resulting perfectly in Newtons per Coulomb (N/C).

4. Why other options are incorrect:

1 J/C defines 1 Volt, not an electric field. 1 J/sec defines 1 Watt of Power. 1 C/m³ represents volumetric charge density.

Question #56 **Key: (C)**

DUHS 2023

Q.173 Which statement is the best for electric flux of a point charge? [SINDH 2023]

1.

CORE CONCEPT AND DERIVATION

According to Gauss's Law, the total outward electrical flux piercing any closed imaginary surface relies only on the amount of charge trapped inside, regardless of how chaotic or asymmetrical the boundary's physical geometry is.

2. Formula:

$$\Phi_E = \frac{Q_{enc}}{\epsilon_0}$$

3. Solution:

- Because the integral of a closed surface fundamentally sums all outward vector lines, reshaping the boundary just changes where the lines exit, not the total count of exiting lines. Thus, flux is completely independent of the enclosing shape.

4. Why other options are incorrect:

Flux directly depends on the magnitude of the charge (ruling out A). It depends heavily on the medium's permittivity ϵ_0 (ruling out B).

Question #57 Key: (A)

DUHS 2023

Q.174 Two capacitors [Formula] and [Formula] are in series connected across a 200 volts D.C supply calculate t...

1.

CORE CONCEPT AND DERIVATION

For any circuit components strung in series, the identical total current must flow through them, guaranteeing that series capacitors hold the exact same magnitude of charge regardless of their individual capacities.

2. Formula:

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2} \quad \text{and} \quad Q = C_{eq} V_{total}$$

3. Solution:

- Find equivalent capacitance: $C_{eq} = \frac{6 \times 12}{6 + 12} = \frac{72}{18} = 4 \mu\text{F}$.
- Calculate the total charge pulled from the supply: $Q_{total} = (4 \times 10^{-6} \text{ F}) \times 200 \text{ V}$.
- Result: $Q_{total} = 800 \times 10^{-6} \text{ C}$.
- Adjusting the decimal for scientific notation yields $8 \times 10^{-4} \text{ C}$.
- Since they are in series, BOTH capacitors possess this identical exact charge.

4. Why other options are incorrect:

Options B and C falsely assume capacitors in series possess different charges. Option D makes a catastrophic error regarding the 'micro' prefix, scaling the answer by a million.

Question #58 Key: (B)

NUMS 2023

Q.175 While studying charging and discharging of a capacitor, $RC =$ Resistance [Formula] capacitance is known a...

1.

CORE CONCEPT AND DERIVATION

In any RC circuit, the mathematical product of the Resistor's resistance and the Capacitor's capacitance specifically dictates how rapidly the circuit responds to changes in voltage.

2. Formula:

$$\tau = R \times C$$

3. Solution:

- Because Ohm *imes* Farad perfectly yields Seconds, this product provides a physical metric for time.
- This specific value (τ) is formally titled the "Time Constant," marking the exact time required to charge to ~63% capacity.

4. Why other options are incorrect:

Dielectric constant (ϵ_r) is an insulation property. Electrostatic constant (k) is used in Coulomb's Law.

Question #59 **Key: (A)**

NUMS 2023

Q.176 In parallel combination of two capacitors, their equivalent capacitance is equal to: [NUMS 2023]

1.

CORE CONCEPT AND DERIVATION

Wiring capacitors in parallel inherently fuses their isolated metal plates into one massive, shared conductive area, which directly aggregates their total individual storage capacities.

2. Formula:

$$C_{eq} = C_1 + C_2 + C_3 + \dots$$

3. Solution:

- Because parallel branches each feel the same total battery voltage, the total combined charge stored by the system is simply $Q_{total} = Q_1 + Q_2$.
- Substituting $Q = CV$ proves that $C_{eq}V = C_1V + C_2V$, allowing the shared voltage to cancel out, leaving straightforward addition.

4. Why other options are incorrect:

Options B and C represent the formulas applied specifically to Capacitors wired strictly in Series, where capacity acts reciprocally.

Question #60 **Key: (C)**

NUMS 2023

Q.177 The SI unit of capacitance of a capacitor is: [NUMS 2023]

1.

CORE CONCEPT AND DERIVATION

The standard unit of electrical capacitance is named in honor of the English physicist Michael Faraday, honoring his contributions to electromagnetism.

2. Formula:

$$1 \text{ Farad} = 1 \frac{\text{Coulomb}}{\text{Volt}}$$

3. Solution:

- By standard definition in the International System of Units (SI), capacitance is measured in Farads (F).

4. Why other options are incorrect:

Coulomb measures electric charge. Volt measures electric potential difference. Ampere measures electric current.

Question #61 Key: (B)

UHS 2022

Q.121 A capacitor is charged with a battery and energy stored is U . After disconnecting battery another capaci...

1.

CORE CONCEPT AND DERIVATION

When a charged capacitor is disconnected, its total charge Q becomes trapped and strictly conserved. Connecting an identical uncharged capacitor in parallel forces the charge to distribute evenly.

2. Formula:

$$U = \frac{Q^2}{2C}$$

3. Solution:

- Initial state: Single capacitor has charge Q . Energy is $U = \frac{Q^2}{2C}$.
- Second state: Because they are identical and parallel, the trapped total charge Q splits perfectly. The new charge on EACH individual capacitor is $Q' = Q/2$.
- Calculate the new energy for ONE capacitor: $U_{each} = \frac{(Q/2)^2}{2C} = \frac{Q^2/4}{2C} = \frac{1}{4} \left(\frac{Q^2}{2C} \right)$.
- Since the original $U = \frac{Q^2}{2C}$, the final energy in each is exactly $U/4$.

4. Why other options are incorrect:

Option A ($U/2$) is the total combined energy left in the entire system, representing the 50% energy lost to heat during charge redistribution. The question asks for the energy in each capacitor, which is half of the remaining total.

Question #62 Key: (C)

UHS 2022

Q.122 What is the potential difference between two points in an electric field if it takes 600J of energy to m...

1.

CORE CONCEPT AND DERIVATION

Potential difference is a direct measure of work accomplished or required per unit of charge.

2. Formula:

$$V = \frac{W}{q}$$

3. Solution:

- Given work energy: $W = 600 \text{ J}$.
- Given charge: $q = 2 \text{ C}$.
- Substitute and divide: $V = \frac{600}{2} = 300 \text{ V}$.

4. Why other options are incorrect:

Option A results from incorrectly multiplying 600 by 2 instead of dividing.

Question #63 Key: (D)

UHS 2022

Q.123 Gauss law cannot be used to find which of the following quantity? [UHS 2022]

1.

CORE CONCEPT AND DERIVATION

Gauss's law serves as a bridge relating an enclosed electrical charge to the electric flux passing through a hypothetical closed surface.

2. Formula:

$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{Q_{\text{enclosed}}}{\epsilon_0}$$

3. Solution:

- The law utilizes electric flux (Φ), charge (Q), and field intensity (E) as its primary mathematical variables.
- Permittivity (ϵ_0) is a universal physical constant (or a fixed medium property). It is a given prerequisite parameter required to use the law, rather than an unknown physical quantity you utilize the law to solve for.

4. Why other options are incorrect:

By rearranging the Gauss's Law equation, one can easily isolate and solve for field intensity, flux, or enclosed charge.

Question #64 Key: (C)

UHS 2022

Q.124 Which one of the following statements is true? [UHS 2022]

1.

CORE CONCEPT AND DERIVATION

Comparing the fundamental forces of nature: Electrostatic forces are immensely powerful compared to Gravity on the scale of fundamental particles.

2. Formula:

$$F_E = k \frac{q_1 q_2}{r^2} \quad \text{vs} \quad F_g = G \frac{m_1 m_2}{r^2}$$

3. Solution:

- Statement A is false: Both forces mathematically feature a $1/r^2$ drop-off, thus both strictly obey the inverse square law.
- Statement B is false: Gravity only attracts; it has no physically proven repulsive counterpart.
- Statement C is true: The electrostatic force between an electron and proton is roughly 10^{39} times stronger than their mutual gravitational pull. Gravity is the weakest fundamental force.

4. Why other options are incorrect:

They contradict the fundamental mathematical structure and empirical strength hierarchies of Newton's and Coulomb's laws.

Question #65 **Key: (D)**

UHS 2022

Q.125 The Coulomb's constant k depends upon? [UHS 2022]

1.

CORE CONCEPT AND DERIVATION

Coulomb's constant k is not a true universal constant like c (speed of light). Its numerical output relies entirely on the intervening environment and how humans choose to measure it.

2. Formula:

$$k = \frac{1}{4\pi\epsilon}$$

3. Solution:

- The permittivity term (ϵ) is dictated by the physical nature of the medium (vacuum vs water vs air).
- The value of k changes if measured in SI units (9×10^9) versus CGS units (where k equals exactly 1). Thus, it heavily depends on the system of units.

4. Why other options are incorrect:

A and B are incomplete on their own. Option C is false because the constant behaves identically regardless of whether the charges are positive or negative.

Question #66 **Key: (A)**

UHS 2022

Q.126 A charged particle is moving in a uniform electric field. For the motion of the particle due to the field...

1.

CORE CONCEPT AND DERIVATION

A uniform electric field provides an unchanging, constant electrostatic force on a charged particle at all points in space.

2. Formula:

$$\vec{F} = q\vec{E} \implies \vec{a} = \frac{q\vec{E}}{m}$$

3. Solution:

- Because both charge (q) and field strength (E) are constant, the resulting force (F) is totally constant.
- By Newton's Second Law, a constant net force results in a constant, unchanging acceleration vector.

4. Why other options are incorrect:

Because the particle is accelerating, its velocity is continuously changing (ruling out D). Displacement is also rapidly changing as it moves (ruling out B). The rate of change of acceleration (jerk) is precisely zero, not non-zero (ruling out C).

Question #67 Key: (B)

UHS 2022

Q.127 A capacitor of capacitance 'C' has a charge 'Q' and stored energy is 'W'. If the charge is increased to ...

1.

CORE CONCEPT AND DERIVATION

The electrical potential energy stored in a capacitor is directly proportional to the square of the charge it holds, assuming capacitance remains constant.

2. Formula:

$$W = \frac{Q^2}{2C}$$

3. Solution:

- Let the initial energy be $W = \frac{Q^2}{2C}$.
- Substitute the new charge $2Q$ into the equation: $W' = \frac{(2Q)^2}{2C}$.
- Expand the square: $W' = \frac{4Q^2}{2C} = 4 \left(\frac{Q^2}{2C} \right)$.
- Therefore, the new energy $W' = 4W$.

4. Why other options are incorrect:

Option A assumes a linear relationship rather than a quadratic one. Options C and D would occur if the charge was decreased rather than increased.

Question #68 Key: (C)

SZABMU 2022

Q.128 Electric intensity due to charge distributions are calculated using which following law? [SZABMU 2022]

1.

CORE CONCEPT AND DERIVATION

Gauss's law relates the electric flux passing through a closed surface to the charge enclosed by that surface, providing a powerful tool to calculate electric fields (intensity) for symmetrical charge distributions.

2. Formula:

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$$

3. Solution:

- By identifying a symmetrical Gaussian surface, the integral simplifies, allowing for the direct algebraic isolation and calculation of the electric field intensity E .

4. Why other options are incorrect:

Ohm's law relates voltage, current, and resistance. Faraday's law deals with electromagnetic induction. Ampere's law calculates magnetic fields from electric currents.

Question #69 Key: (D)

SZABMU 2022

Q.129 The capacitance of capacitor does not depend on: [SZABMU 2022]

1.

CORE CONCEPT AND DERIVATION

The physical capacity of a parallel plate capacitor to store charge is dictated purely by the geometry of the facing surfaces and the insulating material between them.

2. Formula:

$$C = \frac{\epsilon A}{d}$$

3. Solution:

- The formula explicitly relies on Area (A), Separation Distance (d), and the Permittivity of the Medium (ϵ).
- The thickness of the conducting metal plates themselves is mathematically irrelevant to the electrostatic field established in the gap.

4. Why other options are incorrect:

Changing the area, distance, or dielectric medium will physically alter the capacitance value, making options A, B, and C dependent variables.

Question #70 Key: (A)

SZABMU 2022

Q.130 The SI unit of potential difference is: [SZABMU 2022]

1.

CORE CONCEPT AND DERIVATION

Potential difference is the measure of the work done to move a unit of charge. The standardized unit honors Alessandro Volta.

2. Formula:

$$1 \text{ Volt} = 1 \frac{\text{Joule}}{\text{Coulomb}}$$

3. Solution:

- By definition within the International System of Units (SI), the unit of electric potential and potential difference is the Volt.

4. Why other options are incorrect:

Coulomb is the unit of charge. Watt is the unit of power. Electron-volt (eV) is a non-SI unit of energy.

Question #71 Key: (A)

SZABMU 2022

Q.131 Electric potential is defined as: [SZABMU 2022]

1.

CORE CONCEPT AND DERIVATION

Electric potential describes the amount of potential energy per unit of charge at a specific point in space, which equates to the work required to bring that charge from infinity.

2. Formula:

$$V = \frac{W}{q}$$

3. Solution:

- The formula strictly states that Potential (V) is the Work (W) accomplished divided by the Charge (q).

4. Why other options are incorrect:

Force per unit charge defines the Electric Field Intensity (E). Power per unit charge is not a standard electrostatic quantity.

Question #72 Key: (A)

SZABMU 2022

Q.132 [Formula] is equal to: [SZABMU 2022]

1.

CORE CONCEPT AND DERIVATION

An electron-volt is the amount of kinetic energy gained by a single electron accelerating from rest through an electric potential difference of exactly one volt.

2. Formula:

$$E = q\Delta V$$

3. Solution:

- The charge of a single electron is $q = 1.602 \times 10^{-19} \text{ C}$.
- Multiply by 1 Volt: $1 \text{ eV} = (1.602 \times 10^{-19} \text{ C}) \times (1 \text{ V})$.
- Since $1 \text{ C} \cdot 1 \text{ V} = 1 \text{ J}$, the result is $1.602 \times 10^{-19} \text{ J}$.

4. Why other options are incorrect:

The other options feature incorrectly shifted decimal places. The fundamental charge of an electron strictly dictates the 1.602 coefficient.

Question #73 Key: (B)

KMU 2022

Q.133 The energy stored in a capacitor is given by: [ETEA 2022]

1.

CORE CONCEPT AND DERIVATION

The work done to build up charge on a capacitor is stored as electric potential energy. This can be expressed in terms of Capacitance and Voltage.

2. Formula:

$$U = \frac{1}{2} CV^2$$

3. Solution:

- Because voltage increases linearly as charge is added ($V = Q/C$), the average voltage during charging is $\frac{1}{2}V$.
- The total energy is Work = Charge $\times$ Average Voltage = $Q \times (\frac{1}{2}V) = \frac{1}{2}QV$.
- Substituting $Q = CV$ yields $U = \frac{1}{2}(CV)V = \frac{1}{2}CV^2$.

4. Why other options are incorrect:

Option A incorrectly squares the voltage while keeping charge. Option C multiplies charge and capacitance, which is dimensionally invalid for energy.

Question #74 Key: (A)

KMU 2022

Q.134 Two charges one of which is [Formula] and second one is [Formula] are separated by 100 cm. The electric ...

1.

CORE CONCEPT AND DERIVATION

Electric potential is a scalar quantity. The total potential is zero where the positive potential from Q_1 exactly cancels the negative potential from Q_2 .

2. Formula:

$$V_{total} = \frac{kQ_1}{r_1} + \frac{kQ_2}{r_2} = 0$$

3. Solution:

- Let the point be at distance x from Q_1 . The distance from Q_2 is $(100 - x)$.
- Set up the equation: $\frac{k(3\mu C)}{x} + \frac{k(-1\mu C)}{100-x} = 0$.
- Rearrange: $\frac{3}{x} = \frac{1}{100-x}$.
- Cross-multiply: $3(100 - x) = x \implies 300 - 3x = x \implies 4x = 300$.
- Solve for x : $x = 75$ cm from Q_1 .
- The distance from Q_2 is $100 - 75 = 25$ cm.

4. Why other options are incorrect:

Option B is the distance from Q_1 , not Q_2 . Options C and D result from mathematical setup errors or averaging the distances.

Question #75 Key: (B)

BUMHS 2022

Q.135 The electric field intensity at a point situated 4 m from a point charge is 200 N/C. If the distance is ...

1.

CORE CONCEPT AND DERIVATION

The electric field of a point charge obeys the inverse square law. Halving the distance from the source dramatically magnifies the field strength.

2. Formula:

$$E \propto \frac{1}{r^2}$$

3. Solution:

- Original state: $E_1 = 200$ N/C at $r_1 = 4$ m.
- New state: $r_2 = 2$ m, which means the distance is halved ($r_2 = r_1/2$).
- Because E varies inversely with the square of the distance, replacing r with $r/2$ introduces a factor of $1/(1/2)^2 = 1/(1/4) = 4$.
- The new field is 4 times stronger: $200 \times 4 = 800$ N/C.

4. Why other options are incorrect:

Option A incorrectly assumes a linear relationship (distance halved = field doubled). Options C and D are mathematically unrelated to the inverse-square geometric scaling.

Question #76 **Key: (B)**

BUMHS 2022

Q.136 Which type of energy does the capacitor store? [BMU 2022]

1.

CORE CONCEPT AND DERIVATION

A capacitor functions by separating charges, doing work against the electric field, and holding those separated charges static until a circuit is completed.

2. Formula:

$$U_E = \frac{1}{2} CV^2$$

3. Solution:

- Because the charges are held stationary (static) on the opposing plates, the energy is strictly stored as Electrical Potential Energy inside the electric field.

4. Why other options are incorrect:

Kinetic energy involves active motion (like current flowing). Thermal and Light energy describe forms of energy dissipation (like a resistor or bulb), not storage.

Question #77 **Key: (B)**

BUMHS 2022

Q.137 When the distance between two charged particles is halved, the Coulomb force between them becomes [BMU 2...]

1.

CORE CONCEPT AND DERIVATION

The electrostatic force between two charges is intensely sensitive to distance, governed by the inverse square law.

2. Formula:

$$F \propto \frac{1}{r^2}$$

3. Solution:

- Let the original force be F at distance r .
- If the new distance is $r' = r/2$, substitute this into the proportion.
- $F' \propto \frac{1}{(r/2)^2} = \frac{1}{r^2/4} = 4 \left(\frac{1}{r^2} \right)$.
- The resulting force is exactly four times the original.

4. Why other options are incorrect:

Option A occurs if the distance was doubled. Option C implies an inversely linear law, which violates Coulomb's theorem.

Question #78 **Key: (B)**

DUHS 2022

Q.138 In equation [Formula], Negative sign indicates that: [DUHS 2022]

1.

CORE CONCEPT AND DERIVATION

The electric field vector inherently points from regions of positive charge (high potential) toward regions of negative charge (low potential).

2. Formula:

$$\vec{E} = -\nabla V$$

3. Solution:

- The potential gradient formula equates the electric field to the spatial rate of change of voltage.
- The negative sign serves purely as a directional indicator, proving that if you walk strictly in the direction of the Electric field (E), the voltage (V) will steadily decrease.

4. Why other options are incorrect:

If E pointed towards increasing V , the equation would be positive. Field lines and equipotential lines are perpendicular, but this equation describes the gradient line itself, not the equipotential surface.

Question #79 **Key: (D)**

DUHS 2022

Q.139 The electric field intensity between two uniformly, oppositely charged parallel plates is: [DUHS 2022]

1.

CORE CONCEPT AND DERIVATION

The total electric field between two opposite parallel plates is the additive sum of the uniform fields generated independently by each plate.

2. Formula:

$$E = E_{\text{positive}} + E_{\text{negative}}$$

3. Solution:

- A single infinite charged plate generates a field of $E_1 = \frac{\sigma}{2\epsilon_0}$.
- Between two oppositely charged plates, the field vectors point in the exact same direction, reinforcing each other.
- Total Field: $E = \frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0} = \frac{2\sigma}{2\epsilon_0} = \frac{\sigma}{\epsilon_0}$.

4. Why other options are incorrect:

Option A is the field strength for only a single sheet of charge, representing the region outside the plates or if one plate were removed. Options B and C are dimensionally inverted or incorrectly scaled.

Question #80 **Key: (C)**

DUHS 2022

Q.140 If [Formula] and [Formula] capacitors are connected in series. Their equivalent capacitance will be: [DU...]

1.

CORE CONCEPT AND DERIVATION

When capacitors are linked in series, their combined effective plate distance effectively increases, which reduces the total capacitance. We use the reciprocal sum rule.

2. Formula:

$$C_{eq} = \frac{C_1 \times C_2}{C_1 + C_2}$$

3. Solution:

- Identify the values: $C_1 = 2\mu\text{F}$ and $C_2 = 4\mu\text{F}$.
- Multiply them for the numerator: $2 \times 4 = 8$.
- Add them for the denominator: $2 + 4 = 6$.
- Divide: $C_{eq} = 8/6 = 1.33\mu\text{F}$.

4. Why other options are incorrect:

Option D (6) is the answer if they were connected in parallel (simply adding them). Option B (0.75) is the inverted result (6/8), common if a student forgets to flip the final reciprocal fraction.

Question #81 **Key: (B)**

DUHS 2022

Q.141 A proton of charge [Formula] is moved through a P.D of 20 V. The energy gained by the proton is: [DUHS 2...]

1.

CORE CONCEPT AND DERIVATION

The kinetic energy acquired by a charge moving freely through an electrostatic potential difference is simply the mathematical product of the charge and the voltage.

2. Formula:

$$E = q\Delta V$$

3. Solution:

- Given charge: $q = 1.6 \times 10^{-19} \text{ C}$.
- Given potential difference: $V = 20 \text{ V}$.
- Calculate energy: $E = (1.6 \times 10^{-19}) \times 20$.
- Result: $E = 32 \times 10^{-19} \text{ J}$.
- A proton is positively charged, and 'gaining' energy implies a positive increase in kinetic energy, matching the positive value.

4. Why other options are incorrect:

Option A introduces a negative sign, which would apply if calculating the loss of potential energy or moving an electron against the field. Options C and D utilize catastrophically massive positive exponents.

Question #82 Key: (D)

DUHS 2022

Q.142 Two similar point charges, each of 1 coulomb, placed in free space 1m apart, repel each other with a for...

1.

CORE CONCEPT AND DERIVATION

This setup represents the foundational definition of Coulomb's constant k . Finding the force between two exactly 1 Coulomb charges separated by exactly 1 meter effectively outputs the constant itself.

2. Formula:

$$F = k \frac{q_1 q_2}{r^2}$$

3. Solution:

- Given charges: $q_1 = 1 \text{ C}, q_2 = 1 \text{ C}$.
- Given distance: $r = 1 \text{ m}$.
- Substitute: $F = (9 \times 10^9) \frac{1 \times 1}{1^2}$.
- Result: $F = 9 \times 10^9 \text{ N}$.

4. Why other options are incorrect:

Option A is the permittivity of free space (ϵ_0), not the force constant. Option B is the charge of a single electron. Option C naively assumes the variables multiply without the k constant multiplier.

Question #83 Key: (C)

DUHS 2022

Q.143 If a slab of dielectric constant [Formula] is inserted between the parallel plates of a charged [Formula...

1.

CORE CONCEPT AND DERIVATION

Introducing an insulating dielectric material between capacitor plates reduces the internal electric field via polarization, which fundamentally acts to multiply and increase the total capacitance.

2. Formula:

$$C_{med} = \epsilon_r C_{vac}$$

3. Solution:

- Original vacuum capacitance: $C_{vac} = 20 \mu\text{F}$.
- Dielectric constant of new slab: $\epsilon_r = 2$.
- Calculate new capacitance: $C_{med} = 2 \times 20 \mu\text{F} = 40 \mu\text{F}$.
- Because 40 is twice the original 20, the capacitance has precisely doubled.

4. Why other options are incorrect:

Option D occurs if you erroneously divide by the dielectric constant (which happens to field strength, not capacitance). Option B is a distractor for square-law calculations.

Question #84 Key: (A)

NUMS 2022

Q.144 Energy stored in a capacitor is given by: [NUMS 2022]

1.

CORE CONCEPT AND DERIVATION

The electrical potential energy is calculated by integrating the voltage across the capacitor as charge progressively builds up from zero to its maximum.

2. Formula:

$$dU = V \cdot dQ \implies \int_0^Q \frac{q}{C} dq$$

3. Solution:

- Integrating q/C yields $\frac{Q^2}{2C}$.
- Substituting $Q = CV$ into that result gives the standard formula: $E = \frac{1}{2}CV^2$.

4. Why other options are incorrect:

Option C is missing the integral's 1/2 coefficient, representing a capacitor charging instantly at full voltage rather than ramping up. Option D evaluates strictly to Charge (Q), not Energy.

Question #85 Key: (C)

NUMS 2022

Q.145 Electric field intensity is: [NUMS 2022]

1.

CORE CONCEPT AND DERIVATION

Electric field intensity describes the local strength of an electric field, quantified by measuring how hard it pushes or pulls on an established test charge.

2. Formula:

$$\vec{E} = \frac{\vec{F}}{q}$$

3. Solution:

- By mapping exactly to the formula, the vector Field $\vec{E}$ is equal to Force (Newtons) divided by Charge (Coulombs).

4. Why other options are incorrect:

Force per unit mass (Option A) defines the Gravitational Field strength (g). Tesla is a magnetic unit. Watt is a power unit.

Question #86 Key: (A)

NUMS 2022

Q.146 It stores electrical potential energy: [NUMS 2022]

1.

CORE CONCEPT AND DERIVATION

A capacitor is specifically engineered to hold an electrostatic field between isolated parallel plates, fundamentally serving as a short-term energy reservoir.

2. Formula:

$$U_E = \frac{1}{2}CV^2$$

3. Solution:

- When connected to a source, charges accumulate on the plates, establishing an electric field that locks in electrical potential energy until discharged.

4. Why other options are incorrect:

An Inductor stores energy in a Magnetic field, not an electric potential field. A Generator converts mechanical energy into electrical energy dynamically, rather than statically storing it.

Question #87 Key: (A)

PMDC 2021

Q.114 Electric force and electric field intensity for a charge are [NMDCAT 2021]

1.

CORE CONCEPT AND DERIVATION

The electric field is explicitly defined based on the force experienced by a positive test charge. By standard physics convention, unless a negative sign is explicitly provided, we assume standard positive charge behavior.

2. Formula:

$$\vec{F} = q\vec{E}$$

3. Solution:

- Because q is a scalar multiplier, the resulting vector $\vec{F}$ must lie along the exact same line as $\vec{E}$. Thus, they are inherently parallel.

4. Why other options are incorrect:

They are anti-parallel (opposite) strictly for negative charges, but 'parallel' represents the baseline mathematical alignment of the vectors.

Question #88 **Key: (C)**

PMDC 2021

Q.115 A charge Q placed at the centre of two charges $+q$ and $+q$. the system is in equilibrium then net force ...

1.

CORE CONCEPT AND DERIVATION

If a charge is positioned perfectly midway between two identical source charges, the electric fields from the two sources cancel each other out completely.

2. Formula:

$$\sum \vec{F} = \vec{F}_{left} + \vec{F}_{right} = 0$$

3. Solution:

- The source charge on the left pushes/pulls Q with force magnitude $k(q)(Q)/r^2$.
- The source charge on the right pushes/pulls Q with the exact same magnitude $k(q)(Q)/r^2$, but in the perfectly opposite spatial direction.
- By the definition of equilibrium, the sum of all forces is completely zero.
- , the official answer key specifies C as the expected response.*

4. Why other options are incorrect:

Options B and D imply an unbalanced residual force, which physically violates symmetry.

Question #89 **Key: (B)**

PMDC 2021

Q.116 In series combination of capacitors [NMDCAT 2021]

1.

CORE CONCEPT AND DERIVATION

When capacitors are linked in series, their combined ability to store charge decreases, acting reciprocally.

2. Formula:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

3. Solution:

- Find a common denominator to add the fractions: $\frac{1}{C_{eq}} = \frac{C_2 + C_1}{C_1 C_2}$.
- To find the actual equivalent capacitance (C_{eq}), you must invert the entire fraction.
- Result: $C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$ (Product over Sum rule).

4. Why other options are incorrect:

Option A is the formula for Parallel capacitors. Option C is mathematically $1/C_{eq}$, forgetting the final necessary inversion. Option D is an invalid algebraic mashup.

Question #90 **Key: (C)**

PMDC 2021

Q.117 Work done per unit coulomb is equal to [NMDCAT 2021]

1.

CORE CONCEPT AND DERIVATION

This is the fundamental macroscopic definition of voltage (electric potential).

2. Formula:

$$V = \frac{W}{q}$$

3. Solution:

- By defining Joules of work (W) required to move a specific Coulomb count (q), we arrive at Joules/Coulomb. This ratio defines the Volt, which measures Electric Potential.

4. Why other options are incorrect:

Electric field is force per unit charge (Newtons per Coulomb), entirely lacking the distance metric required for 'work'.

Question #91 **Key: (C)**

PMDC 2021

Q.118 Work on charge is equipotential surface is [NMDCAT 2021]

1.

CORE CONCEPT AND DERIVATION

An equipotential surface is a region in space where every single geometric point has the exact same voltage.

2. Formula:

$$W = q\Delta V$$

3. Solution:

- Because the surface has identical voltage everywhere, the difference between any point A and point B is strictly zero ($\Delta V = V_B - V_A = 0$).
- Therefore, $W = q \times 0 = 0$. No net work is done moving across it.

4. Why other options are incorrect:

Positive or negative work requires moving a charge up or down a potential gradient, which does not exist along the surface.

Question #92 **Key: (A)**

PMDC 2021

Q.119 Capacitance of spherical capacitor is [NMDCAT 2021]

1.

CORE CONCEPT AND DERIVATION

A spherical capacitor consists of two concentric conducting spheres of radii a (inner) and b (outer).

2. Formula:

$$C = \frac{Q}{\Delta V} = \frac{4\pi\epsilon_0}{\frac{1}{a} - \frac{1}{b}}$$

3. Solution:

- The potential difference between the spheres is $\Delta V = \frac{Q}{4\pi\epsilon_0} \left(\frac{1}{a} - \frac{1}{b} \right)$.
- Find a common denominator for the radius terms: $\left(\frac{b-a}{ab} \right)$.
- Inverting this when dividing Q by ΔV shifts ab to the numerator, resulting in $C = 4\pi\epsilon_0 \left(\frac{ab}{b-a} \right)$.

4. Why other options are incorrect:

The other options fail to account for the reciprocal geometric derivation resulting from the point-charge potential formula.

Question #93 **Key: (B)**

PMDC 2021

Q.120 For n numbers of Capacitors, each of the capacitance ' C ' what will be the ratio between maximum and mini...

1.

CORE CONCEPT AND DERIVATION

Identical capacitors yield their absolute maximum total capacitance when wired in parallel, and absolute minimum when wired in series.

2. Formula:

$$C_{max} = nC \quad \text{and} \quad C_{min} = \frac{C}{n}$$

3. Solution:

- We must calculate the ratio: $\frac{C_{max}}{C_{min}}$.
- Substitute the expressions: $\frac{nC}{C/n}$.
- The ' C ' variables algebraically cancel out.
- The ' n ' in the denominator's fraction flips up to multiply the numerator: $n \times n = n^2$.

4. Why other options are incorrect:

Option A is the answer if asked only for the maximum multiplier. The true ratio compares the extremes, forcing the n term to square.

Question #94 **Key: (D)**

PMDC 2021

[PMC Practice 8] The energy stored in a parallel plate capacitor is [Formula]. What is the potential differen...

CORE CONCEPT AND DERIVATION

Calculate potential difference from electrostatic potential energy stored in a capacitor's electric field.

Formula:

$$U = \frac{1}{2}CV^2$$

Solution:

Given values:

- Energy stored $U = 24 \text{ J}$
- Capacitance $C = 3\mu\text{F} = 3 \times 10^{-6} \text{ F}$

Rearrange to solve for voltage V :

$$24 = \frac{1}{2} \times (3 \times 10^{-6}) \times V^2$$

$$48 = (3 \times 10^{-6}) \times V^2$$

$$V^2 = \frac{48}{3 \times 10^{-6}} = 16 \times 10^6$$

$$V = \sqrt{16 \times 10^6} = 4 \times 10^3 \text{ V} = 4 \text{ kV}$$

Why other options are incorrect:

- **16 kV** is the value of V^2 without taking the square root.
- Other values arise from simple algebraic mistakes during division or multiplication.

Question #95 **Key: (C)**

PMDC 2020

Q.108 If the potential at a point which is 1m from a charge is 1volt, then the potential at a point which is 2...

1.

CORE CONCEPT AND DERIVATION

The electric potential produced by a point charge is inversely proportional to the linear distance away from it.

2. Formula:

$$V \propto \frac{1}{r}$$

3. Solution:

- The distance changes from 1m to 2m, meaning it has exactly doubled.
- Because V relies on $1/r$, doubling the denominator divides the potential by exactly 2.
- New potential: $V' = 1 \text{ V} / 2 = 0.5 \text{ V}$.

4. Why other options are incorrect:

Option A incorrectly assumes a direct relationship (distance up → potential up). Option B assumes potential is constant regardless of space.

Question #96 **Key: (C)**

PMDC 2020

Q.109 The values of electric intensity will ____ due to the presence of dielectric medium: [NMDCAT 2020]

1.

CORE CONCEPT AND DERIVATION

A dielectric material consists of atoms that polarize when placed in an electric field. This polarization establishes an internal opposing electric field, which acts to reduce the overall net electric intensity.

2. Formula:

$$E_{\text{medium}} = \frac{E_{\text{vacuum}}}{\epsilon_r}$$

3. Solution:

- Because the relative permittivity (ϵ_r) of any real dielectric is strictly greater than 1, dividing the original vacuum field by ϵ_r guarantees that the final field strength mathematically decreases.

4. Why other options are incorrect:

Increasing the field would violate conservation of energy and require the material to actively pump energy into the field, which passive insulators cannot do.

Question #97 **Key: (C)**

PMDC 2020

Q.110 In capacitors, energy is stored in the form of: [NMDCAT 2020]

1.

CORE CONCEPT AND DERIVATION

Capacitors physically store electrical potential energy in the space directly between their conducting plates.

2. Formula:

$$U = \frac{1}{2} \epsilon_0 E^2 (A \cdot d)$$

3. Solution:

- The energy density equation proves that the energy fundamentally resides within the electric field (often referred to as 'electric intensity' in older nomenclature) that bridges the gap between the isolated charges.

4. Why other options are incorrect:

Magnetic energy is strictly stored by Inductors (via current flow). Kinetic energy pertains to motion. Gravitational energy is mass-dependent, not charge-dependent.

Question #98 **Key: (A)**

PMDC 2020

Q.111 Ohm time's farad is equivalent to: [NMDCAT 2020]

1.

CORE CONCEPT AND DERIVATION

In RC circuit theory, multiplying the unit of resistance by the unit of capacitance yields the time constant.

2. Formula:

$$\tau = R \times C$$

3. Solution:

- Let's prove this dimensionally. Ohm (Resistance) = Volts / Amperes = $V / (C/s) = V \cdot s / C$.
- Farad (Capacitance) = Coulombs / Volts = C / V .
- Multiply them: $(V \cdot s / C) \times (C / V)$.
- Volts and Coulombs mutually cancel, leaving only seconds (s), which is the physical dimension of Time.

4. Why other options are incorrect:

Distance and charge have entirely different base dimensional structures. Capacitor is a component, not a unit.

Question #99 Key: (A)

NUMS 2020

Q.112 By increasing area of the plates and decreasing distance between them the capacitance of capacitor: [NUM...]

1.

CORE CONCEPT AND DERIVATION

Capacitance describes a plate's ability to hold charge. A larger surface area allows more charges to gather without repelling each other. A tighter distance increases the attractive pull between opposite plates, allowing even more charge to hold.

2. Formula:

$$C = \frac{\epsilon_0 A}{d}$$

3. Solution:

- If numerator Area (A) is increased, C increases.
- If denominator distance (d) is decreased, C also independently increases.
- Doing both simultaneously compounds the effect, resulting in a large guaranteed increase in total Capacitance.

4. Why other options are incorrect:

Decreasing occurs if you do the exact opposite (decrease area, widen gap). Temperature generally has trivial to no effect on physical plate geometry.

Question #100 Key: (D)

NUMS 2020

Q.113 If we double the separation between two charges, then coulomb's force will become? [NUMS 2020]

1.

CORE CONCEPT AND DERIVATION

Electrostatic force adheres strictly to the inverse square law; force drops dramatically as objects move apart.

2. Formula:

$$F \propto \frac{1}{r^2}$$

3. Solution:

- Let the new separation $r' = 2r$.
- Insert this into the denominator: $(2r)^2 = 4r^2$.
- The 4 remains in the denominator, meaning the new overall force is exactly $1/4$ of the original value.

4. Why other options are incorrect:

Option B occurs if force were inversely linear ($1/r$). Option C occurs if you halved the distance rather than doubled it.

Question #101 Key: (C)

MDCAT 2019

Q.105 Electric field strength of a point charge is E and electric potential is V at a distance r from the poin...

1.

CORE CONCEPT AND DERIVATION

For a point charge, the electric field (E) decays by an inverse-square law, while the electric potential (V) decays inversely with linear distance.

2. Formula:

$$E \propto \frac{1}{r^2} \quad \text{and} \quad V \propto \frac{1}{r}$$

3. Solution:

- If the new field is $E/4$, this means the distance must have been doubled (since $1/(2r)^2 = 1/4r^2$). Let the new distance be $r' = 2r$.
- Since potential depends on $1/r$, applying the new doubled distance gives $V' = \frac{kq}{2r} = \frac{1}{2} \left(\frac{kq}{r} \right)$.
- Therefore, the new potential is $V/2$.

4. Why other options are incorrect:

Option A falsely assumes V decreases at the identical squared rate as E . Option D incorrectly implies that moving further away increases the potential.

Question #102 Key: (C)

MDCAT 2019

Q.106 A particle carrying a charge of [Formula] falls through a potential difference of 25V. What would be ene...

1.

CORE CONCEPT AND DERIVATION

The energy gained by a charge moving across a potential drop is equal to the product of charge and voltage, where fundamental unit 'e' must be expanded to its Coulomb value.

2. Formula:

$$\text{Energy} = q\Delta V$$

3. Solution:

- Identify the charge: $q = 5e$.
- Identify the voltage: $V = 25 \text{ V}$.
- Energy in electron-Volts (eV): $E = (5e)(25 \text{ V}) = 125 \text{ eV}$.
- To convert eV to Joules, substitute $e = 1.6 \times 10^{-19} \text{ C}$.
- Energy in Joules: $E = 125 \times 1.6 \times 10^{-19} \text{ J}$.

4. Why other options are incorrect:

Option A misses the 1.6 multiplier entirely. Option B is simply the charge of a single electron. Option D assumes macroscopic Coulombs rather than elementary charges.

Question #103 Key: (D)

MDCAT 2019

Q.107 Electric field strength at a point between oppositely charge plates is E . If the distance between plates...

1.

CORE CONCEPT AND DERIVATION

For parallel plates held at a constant potential difference, the uniform electric field is directly proportional to voltage and inversely proportional to plate separation.

2. Formula:

$$E = \frac{V}{d}$$

3. Solution:

- Let the original distance be d and the original field be E .
- The new distance is $d' = d/2$.
- Substitute into the formula: $E_{\text{new}} = \frac{V}{d/2} = 2 \left(\frac{V}{d} \right) = 2E$.

4. Why other options are incorrect:

Option B results from a direct proportional misinterpretation (thinking decreasing distance decreases the field). Options A and C confuse uniform field principles with point-charge inverse-square laws.

Question #104 Key: (D)

MDCAT 2018

Q.97 Coulomb's law is given by the formula [Formula]. The magnitude of k having the unit of [Formula] for fre...

1.

CORE CONCEPT AND DERIVATION

Coulomb's constant k characterizes the strength of the electrostatic force in a vacuum or free space.

2. Formula:

$$k = \frac{1}{4\pi\epsilon_0}$$

3. Solution:

- Given the vacuum permittivity $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{N m}^2)$.
- Evaluating $k = \frac{1}{4\pi(8.85 \times 10^{-12})}$ yields approximately 8.99×10^9 , heavily standardized as $9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$ for test purposes.

4. Why other options are incorrect:

They represent incorrect orders of magnitude and incorrect base digits. 9×10^9 is a universally memorized physical constant.

Question #105 Key: (B)

MDCAT 2018

Q.98 Force experienced per unit positive test charge at a point in an electric field is the definition of: [MD...]

1.

CORE CONCEPT AND DERIVATION

While 'electric field' refers to the region of influence, its quantifiable vector magnitude at any specific point is formally defined by its 'strength' or 'intensity'.

2. Formula:

$$\vec{E} = \frac{\vec{F}}{q_0}$$

3. Solution:

- The equation states that if you place a small positive test charge q_0 in a field, the measured force F divided by q_0 yields the exact Electric Field Strength at that spatial point.

4. Why other options are incorrect:

Electric potential energy is work, not force. Electric potential is work per unit charge. 'Electric field' (Option D) is technically true loosely, but 'Electric field strength' is the precise terminology for the quantitative measurement.

Question #106 Key: (B)

MDCAT 2018

Q.99 A torch is rated 2.2 V, 0.25 A. Calculate the charge passing through the bulb in one second and energy tr...

1.

CORE CONCEPT AND DERIVATION

Electrical charge is defined as the product of current and time ($Q = I \times t$). By fundamental definition, the electric potential difference (Voltage) is the work done or energy transferred per unit charge ($V = \frac{W}{Q}$). Therefore, the energy transferred by each coulomb of charge is equal to the voltage.

2. Formula:

$$Q = It \quad \text{and} \quad W = V \times Q$$

3. Solution:

- Charge in one second:**

$$Q = I \times t = (0.25 \text{ A}) \times (1 \text{ s}) = 0.25 \text{ C.}$$

- Energy per coulomb:**

$$\text{By definition of voltage, } V = \frac{W}{Q} \implies W = V \times Q.$$

For each coulomb ($Q = 1 \text{ C}$):

$$W = 2.2 \text{ V} \times 1 \text{ C} = 2.2 \text{ J.}$$

- Historical Exam Key Note:** In MDCAT 2018, the examiner mistakenly calculated total energy in one second ($E_{\text{total}} = VIt = 0.55 \text{ J}$) and marked Option D on the official key. However, the question specifically asks for energy transferred by the passage of *each coulomb of charge*, which is mathematically and physically 2.2 J (Option B).

4. Why other options are incorrect:

- Option A:** Incorrect charge calculation (2.5 C instead of 0.25 C).
- Option B: Correct.** Correctly identifies the charge passed in one second (0.25 C) and the energy transferred per coulomb (2.2 J).
- Option C:** Lists potential difference in volts (2.2 V), but energy must be expressed in joules (J).
- Option D:** Common exam trap. 0.55 J is the total energy transferred by all charges in one second ($E_{\text{total}} = VIt = 0.55 \text{ J}$), not the energy transferred per single coulomb.

Question #107 Key: (D)

MDCAT 2018

Q.100 Electric potential due to [Formula] charge at distance of one meter is equal to [MDCAT 2018]

1.

CORE CONCEPT AND DERIVATION

The electric potential created by a single point charge at a certain distance is calculated linearly using Coulomb's constant.

2. Formula:

$$V = \frac{kq}{r}$$

3. Solution:

- Identify values: $q = 2 \times 10^{-6} \text{ C}$, $r = 1 \text{ m}$, $k = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$.
- Substitute: $V = \frac{(9 \times 10^9)(2 \times 10^{-6})}{1}$
- Simplify powers of 10: $10^9 \times 10^{-6} = 10^3$.
- Calculate: $V = 18 \times 10^3 \text{ V}$.
- Convert to scientific notation: $18 \times 10^3 = 1.8 \times 10^4 \text{ V}$.

4. Why other options are incorrect:

Option A shifts the decimal incorrectly. Options B and C utilize the wrong power of 10, common when failing to substitute $\mu = 10^{-6}$ correctly.

Question #108 Key: (A)

KMU 2018

Q.101 Two determine the resistance of a voltmeter by discharging a capacitor through it, the instantaneous vol...

1.

CORE CONCEPT AND DERIVATION

When a capacitor discharges through a resistor (in this case, the internal resistance of the voltmeter), the voltage across it undergoes exponential decay.

2. Formula:

$$V(t) = V_0 e^{-t/RC}$$

3. Solution:

- During discharge, the potential difference must decrease from its initial value V_0 down toward zero.
- This relies on a negative exponent where time (t) is divided by the time constant ($\tau = RC$).

4. Why other options are incorrect:

Option B represents exponential growth (voltage heading to infinity), which is physically impossible in a passive RC circuit. Options C and D only represent single arbitrary points in time, not the general instantaneous relation.

Question #109 Key: (B)

KMU 2018

Q.102 There are two charges [Formula] and [Formula] the ratio of the force acting on them will be: [ETEA 2018]

1.

CORE CONCEPT AND DERIVATION

By Newton's Third Law, electrostatic force is a mutual interaction. The force one charge exerts on the second is exactly equal in magnitude and opposite in direction to the force the second exerts on the first.

2. Formula:

$$F_{1 \rightarrow 2} = F_{2 \rightarrow 1} = \frac{kq_1q_2}{r^2}$$

3. Solution:

- Charge 1 exerts a force F on Charge 2.
- Charge 2 exerts an identical magnitude force F back on Charge 1.
- The ratio $F : F$ perfectly simplifies to 1:1.

4. Why other options are incorrect:

Options A and D bait students into thinking the force is somehow proportional only to the individual charge experiencing it, rather than the product of both charges.

Question #110 Key: (A)

KMU 2018

Q.103 What is the magnitude of a point charge which produces an electric field of [Formula] at a distance of 6...

1.

CORE CONCEPT AND DERIVATION

The magnitude of an electric field produced by a single point charge falls off with the square of the distance.

2. Formula:

$$E = \frac{kq}{r^2}$$

3. Solution:

- Given field: $E = 2 \text{ N/C}$. Distance $r = 60 \text{ cm} = 0.6 \text{ m}$.
- Rearrange for charge: $q = \frac{Er^2}{k}$.
- Substitute: $q = \frac{2 \times (0.6)^2}{9 \times 10^9}$.
- Square r : $(0.6)^2 = 0.36$. So numerator is $2 \times 0.36 = 0.72$.
- Calculate: $q = \frac{0.72}{9 \times 10^9} = 0.08 \times 10^{-9} \text{ C}$.
- Convert to scientific notation: $0.08 \times 10^{-9} = 8 \times 10^{-11} \text{ C}$.

4. Why other options are incorrect:

Failing to square the 0.6 meters or failing to convert cm to meters correctly leads to the incorrect exponent powers seen in the other options.

Question #111 Key: (C)

KMU 2018

Q.104 The force between two charged bodies is "F". if one of the charge is doubled and the distance between th...

1.

CORE CONCEPT AND DERIVATION

Electrostatic force is directly proportional to the magnitude of the charges and inversely proportional to the **square** of the distance between them.

2. Formula:

$$F_{new} = \frac{k(2q_1)q_2}{(r/2)^2}$$

3. Solution:

- Original force: $F = \frac{kq_1q_2}{r^2}$.
- Substitute new parameters: $F_{new} = \frac{k(2q_1)q_2}{r^2/4}$.
- Bring the denominator fraction up: $F_{new} = 2 \times 4 \times \frac{kq_1q_2}{r^2}$.
- Result: $F_{new} = 8F$.

4. Why other options are incorrect:

Option A results from forgetting to halve the distance. Option B results from forgetting to double the charge. Option D assumes both charges were doubled.

Question #112 Key: (B)

MDCAT 2017

Q.91 A point charge at a distance 'x' from another point charge experiences a force of repulsion, which one of...

1.

CORE CONCEPT AND DERIVATION

The electrostatic repulsion between two point charges follows an inverse square law regarding their separation distance.

2. Formula:

$$F = \frac{kq_1q_2}{x^2} \implies F \propto \frac{1}{x^2}$$

3. Solution:

- Because the force varies as $1/x^2$, the graph of F versus x is not linear.
- As x increases, F decreases rapidly but never truly reaches zero. This forms a steep decaying curve, characteristic of an inverse square relationship.

4. Why other options are incorrect:

A straight line would imply $F \propto -x$, which is incorrect. A positive slope would imply force increases with distance. The true relationship is non-linear and decaying.

Question #113 Key: (B)

MDCAT 2017

Q.92 The Coulomb force between two charges [Formula] and [Formula] is 2N, the distance between charges is 3m. ...

1.

CORE CONCEPT AND DERIVATION

The magnitude of the electrostatic force between two point charges can be found using Coulomb's Law.

2. Formula:

$$F = \frac{kq_1q_2}{r^2}$$

3. Solution:

- Given force: $F = 2 \text{ N}$, charge $q_1 = 2 \text{ C}$, distance $r = 3 \text{ m}$.
- Coulomb's constant is $k = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$.
- Rearrange the formula to solve for q_2 : $q_2 = \frac{F \cdot r^2}{k \cdot q_1}$
- Substitute values: $q_2 = \frac{2 \times 3^2}{(9 \times 10^9) \times 2}$
- Cancel out the 2s and calculate the numerator: $q_2 = \frac{9}{9 \times 10^9} = 1 \times 10^{-9} \text{ C}$

4. Why other options are incorrect:

Option A forgets the negative sign in the exponent. Options C and D result from failing to properly square the distance r or from arithmetic errors.

Question #114 Key: (B)

MDCAT 2017

Q.93 The electric field strength at the position [Formula] caused by a point charge of [Formula] placed at ori...

1.

CORE CONCEPT AND DERIVATION

Electric field in vector form is the product of its magnitude and the unit vector in the direction of the position vector.

2. Formula:

$$\vec{E} = \frac{kq}{r^2} \hat{r} = \frac{kq}{r^3} \vec{r}$$

3. Solution:

- Calculate magnitude of position vector: $r = \sqrt{4^2 + 3^2} = \sqrt{25} = 5 \text{ m}$.
- Calculate the scalar magnitude of the electric field: $E = \frac{9 \times 10^9 \times 5 \times 10^{-6}}{5^2} = \frac{45000}{25} = 1800 \text{ V/m}$.
- Find the unit vector: $\hat{r} = \frac{4\hat{i} + 3\hat{j}}{5}$.
- Multiply magnitude by unit vector: $\vec{E} = 1800 \left(\frac{4\hat{i} + 3\hat{j}}{5} \right)$.
- Simplify: $\vec{E} = 360(4\hat{i} + 3\hat{j}) = 1440\hat{i} + 1080\hat{j} \text{ V/m}$.

4. Why other options are incorrect:

Option C uses incorrect units for electric field (N/m instead of V/m or N/C). Options A and D arise from arithmetic failures during vector component multiplication.

Question #115 Key: (A)

MDCAT 2017

Q.94 If a charge particle is placed one by one at point A, B and C then at which point it will experience a la...

CORE CONCEPT AND DERIVATION

The magnitude of the electric field intensity (E) in any region of space is directly proportional to the density (closeness) of the electric field lines per unit area.

Formula:

The electrostatic force experienced by a charge q in an electric field is given by:

$$F = qE$$

Solution:

- In the given diagram, the electric field lines are **closest together (densest) at point A**, meaning the electric field intensity is greatest at point A ($E_A > E_B > E_C$).
- Since electrostatic force $F = qE$ is directly proportional to electric field strength, the charged particle will experience the **largest force at point A**.

Why other options are incorrect:

- **At point "B" and point "C":** The field lines spread further apart (lower line density), meaning the electric field strength and resulting force are weaker than at point A.
- **Same at all point:** The force would only be uniform if the field lines were parallel and equally spaced (such as between large parallel plates). Here, the field is non-uniform.

Question #116 Key: (A)

KMU 2017

Q.95 The potential of the two plates of a capacitor are +10V and -10V. The charge on one of the plates is 40C....

1.

CORE CONCEPT AND DERIVATION

The capacitance evaluates the amount of charge stored per unit of potential difference **between** the plates.

2. Formula:

$$C = \frac{Q}{\Delta V}$$

3. Solution:

- First, calculate the total potential difference across the plates: $\Delta V = V_+ - V_- = 10 \text{ V} - (-10 \text{ V}) = 20 \text{ V}$.
- Given charge on one plate: $Q = 40 \text{ C}$.
- Substitute into the formula: $C = \frac{40}{20}$
- Result: $C = 2 \text{ F}$.

4. Why other options are incorrect:

Option B results from mistakenly using just 10V instead of the 20V difference ($40/10 = 4$). Option C is the inverse calculation ($20/40 = 0.5$).

Question #117 Key: (D)

KMU 2017

Q.96 The ratio of the electric force between two protons to that between two electrons is of the order of: [ET...]

1.

CORE CONCEPT AND DERIVATION

According to Coulomb's Law, the electrostatic force between two particles depends exclusively on the magnitude of their charges and the distance between them, entirely independent of their masses.

2. Formula:

$$F = \frac{kq_1q_2}{r^2}$$

3. Solution:

- The charge of a proton is $+e$ and the charge of an electron is $-e$. They share the identical charge magnitude (1.6×10^{-19} C).
- At a fixed distance r , the force between two protons is $F_p = \frac{ke^2}{r^2}$.
- At the same distance, the force between two electrons is $F_e = \frac{ke^2}{r^2}$.
- The ratio F_p/F_e is exactly 1.

4. Why other options are incorrect:

Options A, B, and C attempt to bait students into confusing the ratio of electrostatic force with the ratio of *gravitational* vs *electrostatic* force, which scales with mass and leads to large exponents like 10^{39} .

Question #118 Key: (A)

MDCAT 2016

Q.89 If the length, width and separation between the plates of a parallel plate capacitor is doubled then its ...

1.

CORE CONCEPT AND DERIVATION

Capacitance scales with plate area and is inversely proportional to plate separation. The area of rectangular plates is Length $\times$ Width.

2. Formula:

$$C = \frac{\epsilon_0 A}{d} = \frac{\epsilon_0 (L \times W)}{d}$$

3. Solution:

- If length L and width W are doubled, the new area becomes $A' = (2L) \times (2W) = 4(LW) = 4A$.
- The separation d is also doubled, so $d' = 2d$.
- Substitute these into the formula: $C' = \frac{\epsilon_0 (4A)}{2d} = 2 \left(\frac{\epsilon_0 A}{d} \right) = 2C$.
- The net result is a doubled capacitance.

4. Why other options are incorrect:

Option C assumes only area changed. Option D incorrectly multiplies the factors instead of balancing the numerator and denominator.

Question #119 Key: (D)

KMU 2016

Q.90 A charged capacitor stores 10C at 40V. Its stored energy is: [ETEA 2016]

1.

CORE CONCEPT AND DERIVATION

The potential energy stored in a charged capacitor can be found directly if the total charge and potential difference are known.

2. Formula:

$$U = \frac{1}{2}QV$$

3. Solution:

- Given charge: $Q = 10 \text{ C}$.
- Given potential difference: $V = 40 \text{ V}$.
- Calculate: $U = \frac{1}{2}(10)(40)$
- Result: $U = 5 \times 40 = 200 \text{ J}$.

4. Why other options are incorrect:

Option A comes from using $U = Q \times V$, which omits the vital $\frac{1}{2}$ factor representing the average voltage during the charging process.

Question #120 Key: (D)

KMU 2015

Q.88 The unit of the electric field is: [ETEA 2015]

1.

CORE CONCEPT AND DERIVATION

The electric field can be defined mechanically (force per charge) or electrically (potential gradient), leading to equivalent, interchangeable SI units.

2. Formula:

$$E = \frac{F}{q} \quad \text{and} \quad E = \frac{V}{d}$$

3. Solution:

- From $E = F/q$, the unit is Newtons per Coulomb (N/C).
- From $E = V/d$, the unit is Volts per meter (V/m).
- Since 1 Volt = 1 Joule / 1 Coulomb (J/C), substituting this into V/m yields J / (C·m).
- Therefore, all three expressions represent valid units for the electric field.

4. Why other options are incorrect:

Selecting only A, B, or C would be incomplete because all three are physically and dimensionally identical.

Question #121 Key: (C)

MDCAT 2014

Q.85 The distance between the plates of a parallel plate capacitor is 2.0 mm and area of each plates is 2.0 m²...

1.

CORE CONCEPT AND DERIVATION

The physical dimensions of a parallel plate capacitor completely dictate its capacitance in a vacuum/air.

2. Formula:

$$C = \frac{A\epsilon_0}{d}$$

3. Solution:

- Given area: $A = 2.0 \text{ m}^2$.
- Given distance: $d = 2.0 \text{ mm} = 2.0 \times 10^{-3} \text{ m}$.
- Permittivity constant: $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$.
- Substitute values: $C = \frac{(2.0)(8.85 \times 10^{-12})}{2.0 \times 10^{-3}}$
- The 2.0 cancels out, leaving: $C = 8.85 \times 10^{-12} \times 10^3 = 8.85 \times 10^{-9} \text{ F}$.

4. Why other options are incorrect:

The applied voltage is a distractor and does not change the physical capacitance. Other options result from incorrectly utilizing the voltage or making arithmetic errors with the powers of 10.

Question #122 Key: (B)

KMU 2014

Q.86 The direction indicated by an electric field line is: [ETEA 2014]

1.

CORE CONCEPT AND DERIVATION

Electric field lines naturally point outward from positive charge (high potential) to negative charge (low potential).

2. Formula:

$$E = -\frac{\Delta V}{\Delta r}$$

3. Solution:

- The negative sign in the potential gradient formula mathematically proves that the electric field vector always points in the direction of steepest potential drop. Therefore, following an electric field line means the potential must be decreasing.

4. Why other options are incorrect:

Moving along the field line means moving towards negative charge, so potential goes down, not up (Option A). The field strength might increase or decrease depending on the geometry of the source charges, but the potential is guaranteed to decrease.

Question #123 Key: (A)

KMU 2014

Q.87 The potential difference between a pair of similar parallel conducting plates is known. What additional i...

1.

CORE CONCEPT AND DERIVATION

For a uniform electric field generated between two parallel conducting plates, the field strength only depends on the voltage drop and the distance over which that drop occurs.

2. Formula:

$$E = \frac{\Delta V}{d}$$

3. Solution:

- Since ΔV (potential difference) is already known, the only missing variable required to calculate E is d , which represents the separation of the plates.

4. Why other options are incorrect:

Area and permittivity are needed to find the capacitance or the total charge, but they are absolutely unnecessary for finding the electric field strength if the potential difference is already known.

Question #124 Key: (A)

MDCAT 2013

Q.84 What is the charge stored on a [Formula] capacitor charged to the potential difference of 12V? [MCAT 2013...

1.

CORE CONCEPT AND DERIVATION

The total charge stored on a capacitor is the product of its capacitance and the applied potential difference.

2. Formula:

$$Q = CV$$

3. Solution:

- Given values: $C = 5 \times 10^{-6} \text{ F}$ and $V = 12 \text{ V}$.
- Calculate: $Q = (5 \times 10^{-6}) \times 12$
- Result: $Q = 60 \times 10^{-6} \text{ C} = 60 \mu\text{C}$

4. Why other options are incorrect:

Option D forgets the micro (μ) prefix entirely. Options B and C divide 12 by 5 instead of multiplying.

Question #125 Key: (D)

MDCAT 2012

Q.82 10 V potential difference is applied across the plates of 1 F capacitor. What is the energy stored in cap...

1.

CORE CONCEPT AND DERIVATION

The energy stored in the electric field of a capacitor depends on the capacitance and the square of the applied voltage.

2. Formula:

$$U = \frac{1}{2}CV^2$$

3. Solution:

- Identify parameters: $C = 1 \text{ F}$ and $V = 10 \text{ V}$.
- Plug into formula: $U = \frac{1}{2}(1)(10)^2$
- Calculate: $U = \frac{1}{2} \times 100 = 50 \text{ J}$

4. Why other options are incorrect:

Options A and B represent mathematical errors involving metric prefixes. Option C arises from forgetting to square the voltage term ($0.5 \times 1 \times 10 = 5$).

Question #126 Key: (C)

MDCAT 2012

Q.83 What will be the effect on the capacitance of a capacitor if area of each plate is doubled with separatio...

1.

CORE CONCEPT AND DERIVATION

The capacitance of a parallel plate capacitor is directly proportional to the area of its plates and inversely proportional to the distance separating them.

2. Formula:

$$C = \frac{\epsilon_0 A}{d}$$

3. Solution:

- Given changes: New area $A' = 2A$ and new distance $d' = d/2$.
- Substitute into the formula: $C' = \frac{\epsilon_0(2A)}{d/2}$
- Simplify: $C' = \frac{2\epsilon_0 A}{d/2} = 4 \left(\frac{\epsilon_0 A}{d} \right) = 4C$

4. Why other options are incorrect:

Option B would occur if only the area was doubled OR if only the separation was halved. By combining both effects, they multiply ($2 \times 2 = 4$).

Question #127 Key: (A)

KMU 2011

Q.81 The capacitor which charges and discharges quickly will have [ETEA 2011]

1.

CORE CONCEPT AND DERIVATION

The rate at which a capacitor charges or discharges in a circuit depends on its time constant, defined by the product of Resistance and Capacitance.

2. Formula:

$$\tau = RC$$

3. Solution:

- A smaller time constant (τ) indicates that the capacitor will reach its maximum charge (or discharge to zero) in a shorter period of time. Therefore, a quickly discharging circuit must have a small value of RC .

4. Why other options are incorrect:

A large value of RC (which is the same as a large time constant) would cause the capacitor to charge and discharge very slowly.

Question #128 Key: (D)

MDCAT 2010

Q.79 Electric intensity is a vector quantity and its direction is [MCAT 2010]

1.

CORE CONCEPT AND DERIVATION

Electric field intensity ($\vec{E}$) defines the region around a charge where a force is exerted. By convention, its direction is defined relative to a positive test charge.

2. Formula:

$$\vec{E} = \frac{\vec{F}}{q_0}$$

3. Solution:

- Since electric intensity is force per unit positive test charge, the vector $\vec{E}$ points in the exact same direction as the electrostatic force $\vec{F}$ experienced by that positive test charge.

4. Why other options are incorrect:

If it were perpendicular or at an angle, it would violate the vector scalar-multiplication rule $\vec{F} = q\vec{E}$. It is only opposite if the test charge is negative, but the standard definition assumes a positive test charge.

Question #129 Key: (A)

MDCAT 2010

Q.80 The magnitude of an electric field between two separated plates can be calculated by the relation [MCAT 2...

1.

CORE CONCEPT AND DERIVATION

In a uniform electric field, such as between two parallel plates, the relationship between electric field strength, potential difference, and distance is known as the potential gradient.

2. Formula:

$$E = \frac{\Delta V}{d}$$

3. Solution:

- Rearranging the potential gradient formula gives us $\Delta V = E \times d$.

4. Why other options are incorrect:

Option B divides by distance instead of multiplying. Option C incorporates charge which is irrelevant to the direct field-potential relationship. Option D implies the field and potential difference are perfectly identical, ignoring the spatial distance d .

Question #130 Key: (A)

MDCAT 2009

Q.77 A particle carrying charge of [Formula] falls through a potential difference of [Formula]. Calculate the...

1.

CORE CONCEPT AND DERIVATION

The kinetic energy acquired (or work done) by a charged particle moving through a potential difference is equal to the product of its charge and the potential difference.

2. Formula:

$$\Delta K.E = q\Delta V$$

3. Solution:

- Identify the given charge: $q = 2e = 2 \times 1.6 \times 10^{-19} \text{ C}$
- Identify the given potential difference: $\Delta V = 3.0 \text{ V}$
- Substitute the values: $\Delta K.E = (2 \times 1.6 \times 10^{-19} \text{ C}) \times (3.0 \text{ V})$
- Calculate the final value: $3.2 \times 10^{-19} \times 3.0 = 9.6 \times 10^{-19} \text{ J}$

4. Why other options are incorrect:

Option B is the mass of an electron in kg. Option C is the fundamental charge of a single electron. Option D incorrectly assumes a single elementary charge without multiplying by the fundamental charge constant.

Question #131 **Key: (B)**

MDCAT 2009

Q.78 The work done in moving a unit positive charge from one point to another point against the electric field...

1.

CORE CONCEPT AND DERIVATION

The fundamental definition of electric potential difference relates it directly to the work done against an electric field to move a charge.

2. Formula:

$$\Delta V = \frac{W}{q_0}$$

3. Solution:

- By definition, when a unit positive charge ($q_0 = +1 \text{ C}$) is moved against an electric field, the work done (W) is exactly equal to the potential difference (ΔV) between those two points.

4. Why other options are incorrect:

Capacitance relates to charge storage per unit voltage. Electric field intensity is force per unit charge. Resistance opposes the flow of current. Only potential difference is defined as work per unit charge.